

ENGINEERING STANDARD

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware

Selection Guide

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April 15, 1993

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SUBJECT: Engineering Standard JPL STD00009 Revision B Document

Attached is the revised Engineering Standard JPL STD00009, Revision B. "Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide..

Revision B represents a major overall change in format and content from Revision A. Please note that the title has been changed from Revision A, "Preferred Materials, Fasteners, Processes, and Packaging and Cabling Hardware to "Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide". I hope you will find this document user friendly; if not let me know. You, as a customer of this product, can help make this standard more valuable by getting me feedback.

Revision B maintains the same sections as Revision A; however, it contains more detailed information. For example, stress corrosion ratings, tempers, and comments have been added to the Metallics Section. For the Nonmetallics Section, usage, temperature limits, precautionary measures, and metric units have been included. This document does not identify metrics for material or process specifications or metric hardware. This will be included in future amendments or revisions. In addition, materials contained in Revision B include some materials selected and approved by other NASA agencies from the standpoints of stress corrosion, outgassing and flammability. Information on fasteners, packaging, and cabling has also been upgraded, and presented in more detail. Many parts in the Packaging and Cabling Hardware Section have been deleted and replaced with new improved parts, or cross-referenced to JPL D-8208, "Spacecraft Design and Fabrication Requirements for Electronic Packaging and Cabling.. New sections such as Applicable Documents and Alphabetical and Numerical listings of JPL Specifications have been added.

The materials, processes and other items presented in this document should be considered your primary source for JPL spacecraft and instrument design. However, these listed materials can be misused. Consultation with and/or approval of the appropriate specialists is encouraged.

The materials, processes and other items contained in JPL STD00009, Revision B were compiled with the intention of being in agreement with the materials and processes contained in JPL D-8208, "Spacecraft Design and Fabrication Requirements for Electronic Packaging and Cabling", Section 3.18, Polymerics, NASA MSFC HDBK 527, "Materials Selection List for Space Hardware Systems" and MSFC-SPEC-522, "Design Criteria for Controlling Stress Corrosion Cracking..

This latest release of JPL STD00009, Revision B may contain some inadvertent errors or omissions which should be corrected as soon as they are recognized. User comments and correction of discrepancies are welcomed. Errors, omissions, or recommended additions should be submitted to Tim O'Donnell on JPL Amendment Form (JPL 1667 11/86) as described in Appendix E. Please contact Tim O'Donnell, Section 355, Ext. 4-5465, 4-7074, or 4-3726 for further information.

Finally, the support of J. Cork, D. Swenson, and the numerous specialists who prepared or reviewed this document is gratefully appreciated.

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SUBJECT: Acknowledgements

The following individuals have contributed their time and talent to review and revise this document in areas relevant to their technical expertise.

Michael Blakely, Section 358:

In "Packaging and Cabling Hardware", the "Transformer and Inductor Elements" category.

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Pat Dillon, Section 358:

In "Packaging and Cabling Hardware", the "Terminals", "Semiconductor Accessories", "Connectors", "Wire", and "Cabling Accessories" categories.

Cheng Hsieh, Section 355:

General technical expertise, assistance and guidance in the selection of metals in the "Metallic Materials" section, and in the review of the "Fasteners" category.

Jim Kenny, Section 355 "Introduction" and "Purpose and Scope" sections.

Donald Lewis and Richard Rainen, Section 355: "Metallics" category.

Lisa McHugh, Section 355:

"Nonmetallics", "Processes", and "Specifications" categories.

Last but not least, thanks to Frank Hribar and John W. Anderson for their long-term support, patience, and perseverance in overall document coordination.

The efforts of all of these people are very much appreciated and are hereby acknowledged.

CHANGE INCORPORATION LOG

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INTRODUCTION

This Engineering Standard presents space flight materials, processes, fasteners, packaging and cabling hardware. This Standard is intended for use by JPL flight project internal design and fabrication activities and by flight equipment design activities contracted by JPL. This document is compatible with both STS launched payloads and expendable launch payloads.


This Standard may be used as a requirements or guideline document for use on JPL flight projects to the extent specified by each project. This Standard is not generally intended for use by the Deep Space Network, Construction of Facilities, and the Office of Administrative Divisions, but may find some applicability in these activities.

The items listed have been proven by actual usage or by testing as being acceptable when applied within recommended limits. Listed items have not been selected to satisfy all unique requirements and therefore are not given blanket approval for all applications. Design engineers who select items from this document for non-heritage applications without consulting with the appropriate materials, fasteners, or electronic hardware specialists may have difficulty in achieving the desired lifetime and operational success of their flight hardware. If special magnetic, radiation, temperature, or other environmental requirements are imposed, the listed items should be carefully reviewed prior to final selection. Items not listed are not necessarily excluded from consideration for usage. Application and/or usage of items not listed, or where usage and/or application exceeds the recommended limits for listed materials, require a detailed specialist review and concurrence by materials engineering.

Inquiries for detailed information should be directed to the Mechanical Systems Engineering and Research Division personnel as follows: for flight project activities, inquiries should be directed to the Division Technical Support Representative or specific materials engineering, fastener or cabling specialist assigned to project. For nonflight project activities, contact the appropriate specialist organization as follows: Manager, Space Materials Science and Engineering Section, or Mechanical Systems Development Section, or Electronic Equipment Engineering and Fabrication Section.

Changes to this Standard from its last revision are significant and have not been indicated by a heavy black line in the margin. For timely updating, individually changed pages will be dated and listed on a JPL Amendment form and distributed to all holders of this Standard. When sufficient changes warrant, this Standard will be completely revised and reissued showing the next revision letter. All copies of this document will be serialized, and a master list of all holders will be maintained by Vellum Files, M/S 125-B25, Ext. 4-6222. Recipients included in the initial distribution will automatically receive updates as they are released. After initial distribution, contact Vellum Files to be placed on the list for both a serialized copy and subsequent updates.

This Standard supersedes JPL STD00009 Revision A "Preferred Materials, Fasteners, Processes, and Packaging and Cabling Hardware." All suggested changes should be submitted to T. O'Donnell, M/S 125-112, (818) 354-5465, 354-3726 or 354-7074.


L. N. Dumas
Deputy Director

This Engineering Standard, JPL STD00009 Revision B, is the property of the Jet Propulsion Laboratory and is solely for the use of its personnel. The manual shall not be released to others without the written permission of the Jet Propulsion Laboratory.

ISSUED BY

SPACE MATERIALS SCIENCE AND ENGINEERING
SECTION 355

JET PROPULSION LABORATORY

GENERAL INFORMATION

This Engineering Standard is a guide for JPL Engineers and Scientists making material, process and part selections. Applicable materials and processes covered by government, industry and JPL Specifications and Standards are listed and briefly described. Only those materials, processes, fasteners, packaging and cabling hardware with some degree of flight heritage, and only data generally used for selecting a material and process, are included in this Engineering Standard.

Since materials technology and associated specifications are constantly changing, some of the information in this Standard will become obsolete with the passage of time. Engineers of the following JPL Groups are available to provide additional information and make recommendations: the Materials Engineering Group, Space Materials Science and Engineering Section, or the Cabling Engineering Group, and the Mechanical Components Technology Group in the Mechanical Systems Development Section. For assistance from the Electronic Equipment Engineering and Fabrication Section, contact the Electronic Packaging Engineering Group. Early consultation with these engineers can reduce expensive mistakes and costly drawing revisions. Further information may be obtained by calling Tim O'Donnell, ext. 4-5465, 4-3726, or 4-7074.

A typical drawing callout, in accordance with the JPL Drafting Room Manual (DRM) STD00001 format (Figures 2-1 through 2-4 and Figure 3-1) should indicate the appropriate material or process type, class or grade for JPL, government, or industry for a specific application, as shown in the following examples:

TYPICAL MATERIAL CALLOUT**EXAMPLES**

Metallic (Material)

Bar, Alloy Steel 4340, MIL-S-5000, Cond
C 1

Coating (Non-metallic)

Thermal Control Coating, NS43G,
BS516615. Apply per FS516163

Plastic Sheet (Non-metallic)

Plastic Sheet per MIL-P-46112, Type II,
Grade A, 0.001 Inch Thickness

Penetrant (Process)

Inspect Weld per MIL-STD-6866, Type I,
Method B

Surface Treatment (Process)

Anodize per MIL-A-8625, Type II, Class I

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1.0 PURPOSE AND SCOPE

This Engineering Standard provides a list of materials, processes, fasteners, and packaging and cabling hardware, most of which have some degree of acceptable application and constrained flight heritage. This list is targeted for use by JPL and our contractors in the fabrication of space flight hardware.

Mission and Project specific requirements related to safety, function and risk must be considered in the use of the materials, processes and parts listed in this document. The nature of this document is such that previously demonstrated high performance and high reliability materials, processes and parts, and their corresponding preferred specifications, are emphasized.

This Engineering Standard is not a design manual. In general, properties such as strength values, thermal conductivity, dielectric strength, outgassing, etc., are not included. However, in many cases the referenced specifications include minimal acceptable property values. Outgassing levels and flammability ratings are given for all polymeric materials. Issues of design margin and design property values are not within the scope of this document or referenced documents.

The lists in this Standard are, by intent, not all inclusive; items will be added when proven acceptable and qualified by actual use or test.

2.0 REQUIREMENTS AND APPLICABLE DOCUMENTS

2.1 Specifications

2.1.1 General. Materials, processes and parts presented in this Standard shall be procured in accordance with the applicable specifications.

2.1.2 Precedence. Listed specifications shall take precedence. Alternate specifications are subject to review and approval by the appropriate specialists and their organization.

2.2 Applicable Documents

The following documents of their latest issue form a part of this document to the extent specified herein, or are listed for reference purposes only.

2.2.1 Jet Propulsion Laboratory

2.2.1.1 List of JPL Institutionalized Engineering Standards

Number

STD00001	Drafting Manual
STD00002	Preparation of Hardware Specifications
STD00003	Numbering of Engineering Documents
STD00004	Processing of Aperture, Copy and Tabulating Cards
STD00005	JPL Vendor Identification Coding
STD00006	Coding of Engineering Documents
STD00007	Engineering Data Management System (EDMS) Manual
STD00008	Change Procurements Manual for Engineering Documents

STD00009	Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide
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STD00010	Design Standards
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Copies of these Engineering Standards may be obtained from the Master Vellum Center, Extension 4-6222. If you wish to be put on the distribution list for changes, also contact the Master Vellum Center.

2.2.1.2 Other JPL Documents

General Documents

FS500451	Identification and Marking Methods for Parts and Assemblies
----------	--

FS504040	General Specification for Workmanship Standards for Mechanical Parts and Materials
----------	--

TS507035	Vacuum Outgassing of Polymers (Micro- VCM Technique), Detail Specification for
----------	---

JPL D-2003	JPL Engineering Standards Reference List
------------	--

JPL D-5312	Radiation Effects on Non-Electronic Materials Handbook
------------	---

JPL D-6631	Materials Meeting Flammability and Thermal Vacuum Stability Requirements for Space Hardware
------------	---

JPL D-6904	Ground Handling Equipment
------------	---------------------------

JPL D-7723	Guidelines for Materials and Process Engineering Review and Approval of JPL Flight Hardware Drawings
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JPL D-8208	Spacecraft Design and Fabrication Requirements for Electronic Packaging and Cabling
------------	---

JPL EDMG Spec List	Standard List of JPL Specifications
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JPL SPI 4-11-8	Selection of Fasteners for Flight Applications
----------------	--

Project Documents

JPL D-5266	Material and Process Control Requirements for ELV-launched Class B Instruments
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JPL D-9497	Generic Contamination Control Plan for EOS Instruments
------------	--

PD 699-205-3-204	Cassini Environmental Design Requirements
------------------	---

2.3 NASA Documents

NSTS-1700.7B	Safety Policy and Requirements for Payloads Using the Space Transportation System (STS)
--------------	---

NHB 8060-1C	Flammability, Odor and Offgassing Requirements and Test Procedures for Environments that Support Combustion
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NHB 8071.1	Fracture Control Requirements for Payloads Using the National Space Transportation System (NSTS)
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SP 8063	Lubrication, Friction and Wear
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2.4 Johnson Space Center

JSC 02681	Nonmetallic Materials Design Guidelines and Test Data Handbook (Replaced by MSFC 527/JSC 09604)
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SP-R-0022A	Vacuum Stability Requirements of Polymeric Materials for Spacecraft Application
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2.5 Goddard Space Flight Center

GSFC Document	Materials Tips for Spacecraft Applications: (Materials Controls and Applications Branch)
GSFC (Informal Document Series) Revision A	Materials Selection Guide, August 1990
GSFC-NASA Reference Publication 1124	Outgassing Data for Selecting Spacecraft Materials

2.6 Marshall Space Flight Center

MSFC -SPEC-250	Protective Finishes for Space Vehicle Structures and Associated Flight Equipment
MSFC-SPEC-522	Design Criteria for Controlling Stress Corrosion Cracking
MSFC-HDBK-527/JSC 09604	Materials Selection List for Space Hardware Systems (Replaces JSC 02681)
MSFC-SPEC-1246	Non Destructive Evaluation

2.7 Kennedy Space Flight Center

KHB 1700.7	Space Transportation System Payload Ground Safety Handbook
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2.8 Military Documents

DOD	Aerospace Structural Metals Handbook, Mechanical Properties Data Center, Battelle Columbus Laboratory, Columbus, Ohio 43201
DOD/NASA	Advanced Components Designs Guide
DOD-STD-100	Engineering Drawing Practices
MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures

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MIL-STD-12C	Abbreviations for use on Drawings, Specifications, Standards and in Technical Documents
MIL-STD-17	Plastics for Aerospace Vehicles Dissimilar Metals

2.9 Industry/Other

- Metals Handbook, ASM International ASM Metals Handbook
- Structural Metals Handbook, Mechanical Properties Data Center, Battelle Columbus Laboratory
- Damage Tolerant Design Handbook, Metals and Ceramics Information Center, Air Force Materials Laboratory
- Titanium Alloy Handbook MCIC (AFML)
- Cryogenic Materials Handbook (AFML)
- Annual Book of ASTM Standards, for example;
 - E595 Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment, Standard Test Method for

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 3.0 - Materials

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Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 3.0 - Materials

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April 1993

JPL
Jet Propulsion Laboratory
California Institute of Technology

JPL D-9984

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 3. 1 - Metallic Materials

April 1993



Jet Propulsion Laboratory
California Institute of Technology

JPL D-9984

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SECTION 3.1

MATERIALS - METALLIC

The following ratings pertaining to stress corrosion cracking are referenced in the "stress corrosion rating column" for each metallic material as applicable

1. Stress Corrosion Cracking (SCC) Ratings.

The SCC ratings are taken from MSFC-SPEC-522, "Design Criteria for Controlling Stress Corrosion Cracking". The following rating system is used in MSFC-SPEC-522.

Table I. High resistance to SCC.

Table II. Moderate resistance to SCC.

Table III. Low resistance to SCC.

For materials not rated in MSFC-SPEC-522, SCC ratings are taken from MSFC-HDBK-527F/JSC 09604, "Materials Selection List for Space Hardware Systems". The following rating systems are used in MSFC-HDBK-527F/JSC 09604.

A Rating. High resistance to SCC.

B Rating. Moderate resistance to SCC.

C Rating. Low resistance to SCC.

Materials rated either as Table I or "A" are preferred. Table II and III "B" or "C" materials must have their use reviewed by the Materials Engineering Group. Use of materials not rated in either MSFC-SPEC-522 or MSFC-HDBK-527F/JSC 09604 must be reviewed with the Materials Engineering Group prior to use.

Materials with either Table I or "A" rating are preferred.

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SECTION 3.1 METALLIC MATERIALS

Table 3.1-1. ALUMINUM ALLOYS (WROUGHT)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
1100	Sheet, Plate Bar, Rod, Wire (rolled or drawn) Bar, Rod, Wire (extruded) Tube, (drawn seamless) Foil	QQ-A-250/1; ASTM-B209 QQ-A-225/1; ASTM-B211 ASTM-B221 WW-T-700/1; ASTM-B210 QQ-A-1876 ASTM-B479	Table I for all conditions	Good weldability, formability and good corrosion resistance. Use where high strength is not required, e.g., sheet metal work, heat exchangers and light reflectors. Temper: 0, H14, H18.
1145	Foil	QQ-A-1876 ASTM-B479; AMS 4011	Table I for all conditions	For electronic applications: capacitors and electronic component parts and spacecraft louver blades. Good weldability and corrosion resistance.
2017	Bar, Rod, Wire (rolled or drawn)	QQ-A-225/4; ASTM-B211	Table III	—
2024	Sheet, Plate Sheet Plate (alclad) Bar, Rod, Wire (rolled or drawn) Bar, Rod, Wire Shapes, Tube (extruded) Tubing	QQ-A-250/4; ASTM-B209 QQ-A-250/5; ASTM-B209 QQ-A-225/6; ASTM-B209 QQ-A-200/3; ASTM-B221 WW-T-700/3; ASTM-B210	Table I for bar and rod in T8 condition Table II for plate and extrusion in T8 condition; rod and bar in T6 condition	Limited and poor weldability, normally not welded; good strength in T6 and T8 conditions. Used for aircraft/spacecraft structures.
2024	Honeycomb core	MIL-C-7438, Grade C MIL-A-81596, T3 or T81 condition	Table I for T8 condition	Good toughness in T3 and T4 conditions; has good dimensional stability. Typically used in aircraft structures.
2117	Rivet Wire and Rod	QQ-A-430; ASTM-B316	A rating	Use as rivets
2124	Plate	QQ-A-250/29; ASTM-B209	Table II for T8 condition	Limited weldability, normally not welded; has superior fracture toughness to 2024.
2219	Sheet, Plate Bar, Rod, Wire (rolled and drawn) Bar, Rod, Wire, Shapes, Tube (extruded) Tube, (extruded, seamless) Forgings	QQ-A-250/30; ASTM-B209 ASTM-B211 ASTM-B221 ASTM-B241 QQ-A-367; MIL-A-22771; ASTM-B247	Table I for T6 and T8 conditions Table III for T3 and T4 conditions	Good weldability; high strength weldment for cryogenic applications. Has superior mechanical properties at 260–316°C (500–600°F) than other commercial AL alloys. Used for critical structures, space booster oxidizer use and aircraft/supersonic aircraft skin.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-1. ALUMINUM ALLOYS (WROUGHT) (Cont'd)

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
2090	Sheet	AMS 4251	Table II for T8 E41 condition	Recently developed high strength, high modulus, low density (Lithium 2.2%).
3003	Sheet, Plate Bar, Rod, Wire (rolled or drawn) Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Tube, (drawn, seamless) Foil Honeycomb core Pipe, seamless	QQ-A-250/2; ASTM-B209 ~ QQ-A-225/2; ASTM-B211 ~ QQ-A-200/1; ASTM-B221 ASTM-B241 WW-T-700/2; ASTM-B210 MIL-A-81596 MIL-C-7438 MIL-P-25995	Table I for all conditions	Good weldability and good corrosion resistance; pressure vessels, storage tanks. Used where high strength values are not needed, e.g., tubes, pipes, condensers.
4043	Welding Rod	ANSI/AWS A5.10	—*	—
4047 No. 718	Wire Sheet	ANSI/AWS A5.8	—*	Brazing Alloy
5052	Sheet, Plate Bar, Rod, Wire (rolled or drawn) Tube, (extruded, seamless) Tube, (drawn, seamless) Foil Honeycomb core	QQ-A-250/8; ASTM-B209 QQ-A-225/7; ASTM-B211 ~ ASTM-B241 WW-T-700/2; ASTM-B210 MIL-A-81596 MIL-C-7438 Grade B	Table I for all conditions	Low strength very tough alloy, 5000 series; good weldability and good corrosion resistance; used in sheet metal work. High fracture toughness and fatigue strength. Used for fuel oil lines and tanks.
5056	Rivet Wire and Rod Bar, Rod, Wire (rolled or drawn) Foil Honeycomb core	QQ-A-430; ASTM-B316 ASTM-B211 MIL-A-81596 MIL-C-7438 Grade B	Table I for all conditions	Low strength very tough alloy, 5000 series; good weldability and good corrosion resistance; rivets for magnesium. Do not use at 65°C (150°F) and above due to SCC susceptibility.
5083	Sheet, Plate Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Forgings	QQ-A-250/6; ASTM-B209 QQ-A-200/4; ASTM-B221 ASTM-B241 QQ-A-367/4; ASTM-B247	Table I for conditions H111, H112, H116, H117, H323, H343	High strength low toughness alloy, 5000 series; good weldability and good corrosion resistance. Do not use at 65°C (150°F) and above due to SCC susceptibility. Used on aircraft, cryogenic applications, welded pressure vessels, missile components.
5086	Sheet, Plate Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Tube, (drawn, seamless)	QQ-A-250/7; ASTM-B209 QQ-A-200/5; ASTM-B221 ASTM-B241 WW-T-700/5; ASTM-B210	Table I for conditions H111, H112, H116, H117, H323 and H343	Moderate strength and toughness alloy, 5000 series; good weldability and good corrosion resistance. Do not use at 65°C (150°F) and above due to SCC susceptibility.

*Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-1. ALUMINUM ALLOYS (WROUGHT) (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
5456	Sheet, Plate Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Tube, (drawn, seamless)	QQ-A-250/9; ASTM-B209 QQ-A-200/7; ASTM-B221 ASTM-B241 ASTM-B210	Table I for conditions H111, H112, H116, H117, H323 and H343	Has highest strength among 5000 series alloys; good weldability and good corrosion resistance. Used as pressure vessels, welded structures, storage tanks and marine applications. Do not use at 65°C (150°F) and above due to SCC susceptibility.
6013	Sheet	AMS 4347	Table I for all conditions	Recently developed material; 25% higher strength than 6061-T6 sheet. Better formability than 6061. Similar weldability to 6061. Used for aircraft structure.
6053	Rivet wire and Rod	QQ-A-430; ASTM-B316	Table I for all conditions	Fastener for magnesium
6061	Sheet, Plate Bar, Rod, Wire (rolled or drawn) Bar, Rod, Wire Shapes, Tube (extruded) Structural shapes Tube, (extruded, seamless) Tube, (drawn, seamless) Forgings Rivet, Wire and Rod Foil	QQ-A-250/11; ASTM-B209 QQ-A-225/8; ASTM-B211 QQ-A-200/8; ASTM-B221 QQ-A-200/16; ASTM-B308 ASTM-B241 WW-T-700/6; ASTM-B210 QQ-A-367; MIL-A-22771 ASTM-B241 QQ-A-430; ASTM-B316 AMS 4009	Table I for all conditions	Good weldability and good corrosion resistance; good cold workability in the annealed condition; fastener for magnesium. Available in T4 and T6 conditions. Use T6 temper for higher strength; available in alclad form. Galvanic corrosion may occur in direct contact with certain metals. Welded properties lower than parent metal. Used for spacecraft, instrument, aircraft structures, pipelines.
6063	Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Tube, (drawn, seamless) Structural Pipe and Tube (extruded)	QQ-A-200/9; ASTM-B221 ASTM-B241 ASTM-B210 ASTM-B429	Table I for all conditions	Good weldability; has better corrosion resistance than 6061.
7049	Forgings Extrusions	QQ-A-367; AMS 4111 AMS 4157	Table I for T73 Table II for T76	High strength and good corrosion resistance. Used for aircraft main frame forgings, pressure vessels, storage tanks, tubes, pipes, and condensers.
7050	Plate Hand Forging Die Forging Extruded, Shapes	AMS 4050; AMS 4201 AMS 4108 AMS 4107 AMS 4340; AMS 4341	Table I for T73 Table II for T74 and T76	High strength and good corrosion resistance. Sheet form not readily available. High fracture toughness and fatigue strength. Used as work horse alloy in current aircraft structures. Welding not recommended.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-1. ALUMINUM ALLOYS (WROUGHT) (Cont'd)

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
7075	Sheet, Plate Bar, Rod, Wire (rolled or drawn) Bar, Rod, Wire Shapes, Tube (extruded) Tube, (extruded, seamless) Tube, (drawn, seamless) Forgings Rivet wire	QQ-A-250/12; ASTM-B209 QQ-A-225/9; ASTM-B211 QQ-A-200/11; ASTM-B221 ASTM-B241 WW-T-700/7; ASTM-B210 QQ-A-367; MIL-A-22771 ASTM-B247 QQ-A-430; ASTM-B316	Table I for T73, Table II for T76 Table III for T6	Not weldable; very high strength, used for spacecraft structural applications. Usually used in T73 condition for acceptable SCC rating. Available also in alclad form.
7150	Plate Extrusion	AMS 4252 (G7751) AMS 4345 (T77511)	TBD	Recently developed material; very high strength. Not weldable. Used for aircraft wing structure.
7475	Sheet Plate Clad Sheet	AMS 4084(T61); AMS 4085(T761) AMS 4090(T651); AMS 4089(T7651); QQ-A-250/5 AMS 4207(T61);	Table I for T73 Table II for T76 Table III for T6	Not weldable; very high strength; has higher fracture toughness than 7075. Used for aircraft fuselage, wing skins, spars and bulkheads.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-2. ALUMINUM ALLOYS (CASTINGS)

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
355.0 C355.0	Permanent Mold Casting Sand Castings High Strength Casting	QQ-A-596; ASTM-B108 ASTM-B26 MIL-A-21180 (C355.0)	Table I for T6	Good weldability, stability and good pressure tightness; C355.0 has higher strength than 355.0. Used for engine crankcases.
356.0 A356.0	Permanent Mold Casting Sand Castings High Strength Casting	QQ-A-596; ASTM-B108 ASTM-B26/B26M MIL-A-21180 (A356.0)	Table I for all conditions	Good weldability, good corrosion resistance and good pressure tightness. A356.0 has higher strength and considerably higher ductility than 356.0. Used for aircraft fittings and pump parts.
357.0 A357.0	Permanent Mold Casting Sand Castings High Strength Casting	QQ-A-596; ASTM-B108 ASTM-B26 MIL-A-21180 (A357.0)	Table I for all conditions for 357.0	High strength casting; good weldability, good corrosion resistance. A357.0 has excellent resistance to SCC. These materials have higher strength than 356.0 and A365.0.
535.0* (Almag 35)	Sand Castings	QQ-A-371 ASTM-B26	Table I for as cast condition	Better corrosion resistance than A356.0, A357.0 and C355.0. Not used in welded condition. Has good machinability; contains beryllium.* Used for computer and electrical equipment and guidance systems.

***WARNING:** Because this material contains beryllium, work that produces dust or fumes requires special safety measures.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-3. COBALT ALLOYS

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Haynes 25 (L605)	Sheet Bar, Forgings	AMS 5531 (annealed) AMS 5759 (annealed)	Table I for all conditions	A corrosion and heat resistant alloy used for moderately stressed parts between 538° to 1038°C (1000° to 1900°F).
Haynes 188	Sheet, Plate Bar, Forgings	AMS 5608 (annealed) AMS 5772 (annealed)	Table I for all conditions	A corrosion and heat resistant alloy used for up to 1149°C (2100°F).
MP35N	Bar	AMS 5844 (solution treated and cold drawn) AMS 5844 (solution treated, cold drawn, and aged)	Table I for all conditions	High strength good ductility, excellent corrosion and oxidation resistance, up to 400°C (750°F). Used for fasteners.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-4. COPPER AND COPPER ALLOYS

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Alloy 102 (Oxygen Free High Con- ductivity) C10200	Sheet, Plate, Strip Bar, Rod, Shapes Tubing Wire	ASTM-B152, AMS 4501 ASTM-B133; ASTM-B272 ASTM-B75; MIL-T-24107 AMS 4701; QQ-W-343 MIL-W-3318	A Rating	Excellent workability; use as waveguide, electric conductors, microwave tubes, cables, copper to glass seals in electronic applications.
Alloy 110 (Electro- lytic Tough Pitch) C11000	Sheet, Plate, Strip Bar, Rod, Shapes Tubing Wire	ASTM-B152, AMS 4500 ASTM-B133; ASTM-B272 WW-T-799 QQ-W-343	Table I for 37% cold rolled condition	Excellent workability; use as a conductivity wire, contact, switches, terminals, rivets, anodes, soldering copper.
Alloy 120 (Phos- phorous De- oxidized) C12000	Sheet, Plate Tubing Shapes, Rod	ASTM-B133; ASTM-B152 ASTM-B75 ASTM-B133; ASTM-B187	—*	Excellent workability; use as busbars, electrical conductors, tubular bus and applications requiring welding or brazing.
Alloy 122 (Phos- phorized De- oxidized Copper) C12200	Tubing	ASTM-B75	—*	Uses: Air, gas, oil, water lines; plumbing pipe and tube; air conditioners. Good soldering, brazing and resistance welding.
Alloy** 172 (Beryl- lium Copper) C17200	Strip Bar, Rod, Wire Shapes Tubing	ASTM-B194; ASTM-B196 ASTM-B194; ASTM-B196; ASTM-B197 ASTM-B570 ASTM-B643	Table I for AT and HT conditions	Excellent workability; precipitation hardenable. Use as electronic and electrical conductors, springs, switches, bushings, bearings, instrument tubing, flexures and bellows.
Alloy 230 (Red Brass) C2300	Sheet, Plate, Strip Wire Tubing	ASTM-B36; ASTM-B134 ASTM-B134 ASTM-B111; ASTM-B135; ASTM-B359	Table I for 40% cold rolled condition	Excellent cold workability. Use as conduit, screw shells, sockets, fasteners, heat exchange, tubing, radiator cores.

*Stress corrosion rating undetermined and could not be found.

** WARNING: Because this material contains beryllium, work that produces dust or fumes
requires special safety measures.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-4. COPPER AND COPPER ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Alloy 260 (Cartridge Brass) C26000	Sheet, Plate, Strip Bar, Rod, Shapes Tubing Wire	ASTM-B36; ASTM-B134; ASTM-B121 ASTM-B129 ASTM-B135; ASTM-B587 ASTM-B134	Table III for 50% cold rolled condition	Excellent cold workability. Use as radiator cores and tank, fasteners, locks, hinges, rivets, pins.
Alloy 360 (Free cutting brass) Comp.22 C36000	Flat Products: Plate, Sheet, Strip Rod, Bar, Shapes	ASTM-B36, -B121 ASTM-B26; ASTM-B121 AMS 4610 ASTM-B16 SAE J463	C rating	Copper-lead-zinc-alloy, free-cutting brass. Uses: locks, plates, nuts, gears, wheels. Temper must be specified as required. Excellent machinability. Low ductility and resistance to SCC.
Alloy 510 (Phosphor Bronze) C51000	Sheet, Plate, Strip Bar, Rod, Shapes Wire	ASTM-B139 ASTM-B139 ASTM-B159	Table I for 37% cold-rolled condition	Excellent cold workability; use as bellows, cotter pins, fasteners, lock washers, wire brushes, diaphragms, and welding rods.
Alloy 524 (Phosphor Bronze) C52400	Sheet, Plate, Strip Bar, Rod, Shapes Wire	ASTM-B139 ASTM-B139 ASTM-B159	A rating Table I for cold rolled condition	Excellent cold workability; good wear and corrosion resistance; good fatigue resistance. Use as bars, plates, and fittings.
Alloy 706 (Copper-Nickel 10% Ni) C70600	Sheet, Plate, Strip Rod, Bar Tubing Ribbon Wire (gold-plated)	ASTM-B122; ASTM-B151 ASTM-B171; ASTM-B151; MIL-C-15726 ASTM-B111; ASTM-B359 ASTM-B395; ASTM-B543 ZMS-4502-0001 ZMS-4502-0002	Table I for 50% cold rolled condition	Good hot and cold workability. Used for condensers, heat exchanger tubing, ferrules.
Alloy 715 (Copper-Nickel 30% Ni) C71500	Sheet, Plate, Strip Rod, Bar Tubing	ASTM-B122; ASTM-B151 ASTM-B151 ASTM-B151; MIL-C-15726 ASTM-B111; ASTM-B359 ASTM-B395; ASTM-B543	A Rating	Good hot and cold workability. Used for condensers, heat exchanger tubing, ferrules.
Copper foil, rolled and annealed	Foil	IPC-CF-150	—*	Conductor foil for flexible printed circuits.
Copper Foil	JTCS-HTE JTC (Electro-Deposited)	IPC-CF-150	—*	Copper foil thickness shall be 1/2 oz. (0.0018 mm or 0.00007 in.) or greater. Class B flexible printed wiring foil shall be selected from annealed-wrought Class 7 or rolled-wrought low temperature annealable Class 8 as specified in IPC-CF-150.

*Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-5. IRON-BASE SUPERALLOYS

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
A286	Sheet, Plate, Strip Bars, Tubing, Forgings Bars, Tubing, Forgings Bars, Tubing, Forgings Bars, Tubing, Forgings	AMS 5525 982°C (1800°F) solution treated AMS 5731 982°C (1800°F) solution treated AMS 5732 982°C (1800°F) solution treated and aged AMS 5734 900°C (1650°F) solution treated AMS 5737 900°C (1650°F) solution treated and aged	Table I for all conditions	An age hardenable material for parts requiring good strength up to 704°C (1300°F). Typical applications include jet engine parts, turbine blades and fasteners.
Incoloy 800	Sheet, Plate, Strip Bar, Rod Bar, Forgings Welded Pipe Seamless Pipe and Tubing	ASTM-B409; AMS 5871 ASTM-B408 AMS 5766 ASTM-B514 ASTM-B407	Table I for all conditions	Good weldability. Used for low-stressed parts requiring corrosion and oxidation resistance up to 1150°C (2100°F).

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-6. MAGNESIUM ALLOYS

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
AZ31B	Sheet, Plate Extruded Bar, Rod, Shapes Extruded Tubes Forgings	ASTM-B90; AMS 4375; AMS 4376; AMS 4377 ASTM-B107 WW-T-825; ASTM-B107 QQ-M-40; ASTM-B91	Table II for all conditions	General purpose alloy for low stress applications
AZ61A	Extruded Bar, Rod, Shapes Extruded Tubes Forgings	ASTM-B107 WW-T-825; ASTM-B107 QQ-M-40; ASTM-B91	Table III for all conditions	For applications requiring higher strength than AZ31B.
AZ80A	Extruded Bar, Rod, Shapes Extruded Tubes Forgings	ASTM-B107 ASTM-B107 QQ-M-40; ASTM-B91	Table III for all conditions	Heat treatable alloy; has higher strength than AZ61A.
AZ91A	Die Casting (AZ91A and AZ91B) Sand Casting (AZ91C) Permanent Mold Casting (AZ91C) Investment Casting (AZ91C)	QQ-M-38; ASTM-B94; AMS 4490 QQ-M-56; ASTM-B80; AMS 4437; MIL-M-46062 QQ-M-55; ASTM-B199; MIL-M-46062 ASTM-B403; AMS 4452	—*	Good dimensional accuracy; excellent surface finish; least expensive for high production runs. Temper F for AZ91A.
LA141A	Sheet, Plate Forgings	MIL-M-46130; ASTM-B90 AMS 4386 MIL-M-46130	Table I for T7 condition	Magnesium-Lithium alloy. Formed parts requiring light weight (This alloy has 14% lithium); weldable.
ZK60A	Extruded Bar, Rod, Shapes Extruded Tubes Forgings	ASTM-B107; AMS 4352 WW-T-825; ASTM-B107 QQ-M-40; ASTM-B91; AMS 4362	Table II for all conditions	For highly-stressed parts requiring better ductility than AZ80A.

*Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-7. NICKEL AND NICKEL ALLOYS

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Nickel	Ribbon	ZMS-4506-0001 MIL-N-46025	A rating	---
Nickel	Wire (bare and gold-plated)	BS 501429 MIL-N-46025	A rating	---
Nickel 200 and 201	Sheet, Plate, Strip Bar, Rod Tube, Pipe, Seamless Ribbon and Wire	ASTM-B160 (Nickel 200) AMS 5553 (Nickel 201) ASTM-B160 ASTM-B161 (Nickel 201) MIL-N-46026 (Nickel 201)	A rating	Nickel 201 is the low carbon version of Nickel 200 and is preferred to Nickel 200 for applications above 316°C (600°F). Use for electronic components, plater bars, caustic evaporators.
Inconel 600	Sheet, Plate, Strip Bar, Rod, Forgings Pipe and Tubing Wire	ASTM-B168; MIL-N-22986; MIL-N-23228; AMS 5540 ASTM-B166; ASTM-B564; MIL-N-23229; AMS 5665 MIL-T-22945; MIL-T-23227; ASTM-B167; AMS 5580 QQ-W-390; AMS 5687; AMS 7232	Table I for annealed condition	Good corrosion resistance, good workability and strength. Use for engine and air-frame components such as exhaust liners, turbine seals; also use as tube support members, and springs in the electronic field.
Rene' 41 (Cr-Co-Mo-Ti)	Plate, Sheet, Strip Bar, Forgings Castings Welding Wire	AMS 5545 AMS 5712 AMS 5399 AMS 5800	Table I all conditions	Heat treatable nickel base alloy having excellent properties up to 982°C (1800°F). Readily formed and weldable but susceptible to strain age cracking in weld parts used in jet turbines and rocket engines. May be fusion welded in solution-treated condition with good joint strength and ductility; may also be brazed. Good corrosion resistance.
Inconel 625	Sheet, Plate, Strip Rod, Forging Stock Pipe and Tube	ASTM-B443; AMS 5599 ASTM-B446; ASM 5666 ASTM-B444	Table I for annealed condition	Good oxidation resistance. Has exceptional fatigue strength from cryogenic temperatures up to 982°C (1800°F). Good weldability, brazeability and resistance to corrosive environments.
Inconel 718	Sheet, Plate, Strip Bar, Forgings Tubing, seamless	AMS 5596; AMS 5597 AMS 5662; AMS 5663; AMS 5664 AMS 5589; AMS 5590	Table I all conditions	Precipitation hardenable and weldable in the fully hardened condition; has excellent oxidation resistance. Use for gas turbine components, pump body and parts in aerospace industry. Suitable for cryogenic applications and temperatures up to 704°C (1300°F).

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-7. NICKEL AND NICKEL ALLOYS (Cont'd)

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Inconel X-750	Sheet, Plate, Strip Bar, Rod, Forging Pipe and Tube Wire	MIL-N-7786; AMS 5542; AMS 5598 MIL-N-24114; AMS 5766; MIL-N-8850; MIL-S-23192; AMS 5671 AMS 5668 AMS 5676 AMS 5582 MIL-S-21977; AMS 5698 AMS 5699	Table I all conditions	Intended for long service life at temperatures from 427° to 593°C (800° to 1100°F). Good impact strength to -196°C (-320°F). Precipitation hardenable for use up to 816°C (1500°F). Use in gas turbines, thermal processing, spring temper- wire at elevated temperatures. Good resistance to oxidation and corrosion. Weldable in solution-treated condition by fusion or resistance methods; good formability.
Monel 400	Sheet, Plate, Strip Bar, Rod, Forging Pipe and Tube Wire	QQ-N-281; ASTM-B127; AMS 4544 MIL-N-24106; MIL-N-894; QQ-N-281; ASTM-B164; AMS 4675 MIL-T-23520 MIL-T-1368; QQ-N-281; ASTM-B165 MIL-N-984; QQ-N-281; AMS 7233	A rating	A weldable nickel copper alloy with excellent corrosion resistance; Use for valves, pumps, shafts, fasteners.
Monel K-500	Form 1, Rod, Forging, Bars, Flats Form 3, Sheet Form 4, Strip Form 6, Plate Form 5, Wire	QQ-N-286 QQ-N-286	Table I all conditions	Corrosion resistant nickel- copper base alloy. High strength and hardness; excellent low temperature strength and toughness and virtually non-magnetic. Good dimensional stability. Is weldable, brazeable and solderable. Machineable in annealed condition.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-8. SOLDER ALLOYS

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Ag 2.5	Solder, bar Solder, resin cored Solder, wire	QQ-S-571	A rating	Maximum service temperature is 194°C (382°F); match closely CTE* of joining materials.
Sb 5	Solder, bar Solder, resin cored Solder, wire	QQ-S-571	A rating	Maximum service temperature is 149°C (300°F); match closely CTE of joining materials.
Sn 60 and Sn 63	Solder, bar Solder, non-activated resin cored Solder, mildly-activated resin cored Solder, wire	QQ-S-571 BS 502516 Class 1 BS 502516 Class 2 QQ-S-571	A rating	Maximum service temperature is 89°C (192°F); match closely CTE of joining materials.
SN 62	Solder, bar Solder, resin cored Solder, wire	QQ-S-571	A rating	Use for soldering chip components; nominal composition, contains 2 percent silver
SN 96	Solder, bar Solder, resin cored Solder, wire	QQ-S-571	A rating	Maximum service temperature is 139°C (283°F); match closely CTE of joining materials.
Indalloy 2	Solder, wire Solder, foil Solder, ribbon Solder, powder Solder, paste Solder, spheres Solder, shot	QQ-S-571	—**	Use for soldering electronic components to thin gold films. Good thermal fatigue properties. Compatible with Indalloys 7, 10, 150, 204, 205 and 206. Also used for glass to metal vacuum seals. Solidus temperature 149°C (301°F). Has low creep and sustained load carrying capability.
Indalloy 7	Solder, wire Solder, foil Solder, ribbon Solder, powder Solder, paste Solder, spheres Solder, shot	QQ-S-571	—**	Use for soldering electronic components to thin gold films. Has minimum gold leaching characteristics of lead-indium alloys. Good thermal fatigue properties. Solidus temperature 180°C (356°F).
Indalloy 204	Solder, wire Solder, foil Solder, ribbon Solder, powder Solder, paste Solder, spheres Solder, shot	QQ-S-571	—**	Use for soldering electronic components to thin gold films. Has minimum gold leaching characteristics of lead-indium alloys. Good thermal fatigue properties. Solidus temperature 160°C (320°F).

* Coefficient of Thermal Expansion

**Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-9. STEEL, CARBON AND LOW ALLOY

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
1018- 1025	Bar Plate Sheet	ASTM-A108 ASTM-A827 MIL-S-7952	Table I for all forms below 1240 MPa (180 ksi) UTS (see comments)	Between 1240 MPa (180 ksi) and 1380 MPa (200 ksi) UTS* classified as Table II. Table III above 1380 MPa (200 ksi) UTS.
1095	Bar Sheet, Strip	MIL-S-8559 MIL-S-7947	Table I for all forms below 1240 MPa (180 ksi) UTS (see comments)	Between 1240 MPa (180 ksi) and 1380 MPa (200 ksi) UTS classified as Table II. Table III above 1380 MPa (200 ksi) UTS.
4130	Bar, Shapes, Forgings Sheet, Strip, Plate Tubing	MIL-S-6758 MIL-S-18729 MIL-T-6736	Table I for all forms below 1240 MPa (180 ksi) UTS (see comments)	Between 1240 MPa (180 ksi) and 1380 MPa (200 ksi) UTS classified as Table II. Table III above 1380 MPa (200 ksi) UTS.
4140	Sheet, Strip, Plate Bar, Rod, Forgings Tubing	SAE/AMS 6395 MIL-S-5626 AMS 6390	Table I for all forms below 1240 MPa (180 ksi) UTS (see comments)	Between 1240 MPa (180 ksi) and 1380 MPa (200 ksi) UTS classified as Table II. Table III above 1380 MPa (200 ksi) UTS.
4340	Sheet, Strip, Plate Bar, Shapes, Tubing	QQ-S-627 MIL-S-5000 AMS 6415	Table I for all forms below 1240 MPa (180 ksi) UTS (see comments)	Between 1240 MPa (180 ksi) and 1380 MPa (200 ksi) UTS classified as Table II. Table III above 1380 MPa (200 ksi) UTS.
52100	Bars	MIL-S-7420	C rating	Use for ball or roller bearings and similar applications.
High Carbon	Wire Strip	ASTM A228 MIL-S-46049	Table I in tempered condition	Similar to 1095

* Ultimate tensile strength

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-10. STEEL, MARAGING

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
18% Nickel Maraging Grade 250	Bar, Plate, Sheet, Strip	MIL-S-46850, Type III, Grade 250 AMS 6520	Table III condition: aged at 482°C (900°F)	A highly alloyed (Mo, Co, Ti, Al) low carbon Fe-Ni maraging steel with high resistance to crack propagation. Used for aircraft, missile and aerospace structures; has superior mechanical properties and weldability; tooling-excellent mechanical properties and superior fabricability; used for large solid rocket motor boosters and pressure vessels. Usage under low sustaining tensile stress. Welding requires special precautions.
18% Nickel Maraging Grade 300	Bar, Plate, Sheet, Strip	MIL-S-46850, Type III, Grade 300 AMS 6520	Table III condition: aged at 482°C (900°F)	A highly alloyed (Mo, Co, Ti, Al) low carbon Fe-Ni maraging steel with high resistance to crack propagation. Used for aircraft, missile and aerospace structures; has superior mechanical properties and weldability; tooling-excellent mechanical properties and superior fabricability; used for large solid rocket motor boosters and pressure vessels. Usage under low sustaining tensile stress. Welding requires special precautions. Grade 300 has 1.5% more Co than Grade 250.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-11. STEEL, STAINLESS, AGE HARDENABLE

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
15-5 PH	Bar, Forgings, Plate	AMS 5659 MIL-STD-163	Table I H1000 and above.	Nitrided surface adds to resistance to galling and wear. Post weld heat treat imparts weld properties similar to parent metal. Superior to 17-4 PH.
Custom 455	Steel Tubing, Welded Bar, Forgings Sheet, Strip, Plate Wire	AMS 5578 AMS 5617A AMS 5860 AMS 5672	Table I H1000 and above.	Applications: cryogenics, ring seals, bearings, pressure vessels, gears, shafts, fasteners, nuclear. Use where fracture toughness is required.
PH15-7 MO AISI No. 632	Sheet, Strip, Plate Bars and Forgings Welding Wire	AMS 5520 AMS 5657 AMS 5812	Table I CH 900 condition	A semi-austenitic precipitation-hardening stainless steel, modified 17-7 PH alloy. Mo is substituted for Cr. Utilization temperature up to 538°C (1000°F). Intergranular corrosion sensitive during acid pickling. Hydrogen embrittlement can occur during plating. Fusion welding (GTAW) yields weld efficiency of 80–100%. Has good formability.
17-7PH	Sheet, Strip, Plate (Cond. A and TH 1050) Sheet, Strip, Plate (Cond. A and CH 900) Bar, Forgings (Cond. A and TH 1050) Tubing, Welded Wire, Spring Temper	AMS 5528 MIL-S-25034 AMS 5529 AMS 5504 AMS 5568 AMS 5673	Table I CH 900 condition	A nearly austenitic stainless steel with superior corrosion resistance. Use at temperature up to 432°C (810°F). CAUTION: Reduced propagation resistance and brittleness occurs at cryogenic temperatures. Susceptible to instability at elevated temperatures.
PH13-8 MO	Bars, Wire, Forgings, Tubing, Rings	AMS 5629	Table II all conditions	Avoid tempering between 324 and 593°C (700 and 1100°F) because it lowers SCC and corrosion resistance. Used for F _{ty} * up to 1520 MPa (220 ksi). Used for machined fasteners, gear parts, pins and lockwashers. Nuclear radiation increases strength, but reduces ductility and fatigue.

* Tensile yield strength

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-12. STEEL, STAINLESS, AUSTENITIC

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
301, 302	Sheet, Strip, Plate Sheet, Strip, Plate (1/4 H) Sheet, Strip, Plate (1/2 H) Sheet, Strip, Plate (Full H) Bar (to 100 ksi) Bar, Forgings	MIL-S-5059; AMS 5516 AMS 5517 AMS 5518 AMS 5519 AMS 5637A MIL-S-7720 (302)	Table I all conditions	Good formability at any given strength level. 302 is inferior to 301 in strength. Corrosion and oxidation resistance improve as Cr and Ni content increases; weld and HAZ* susceptible to intergranular corrosion.
302 (condition B)	Wire (springs)	ASTM-A580, A-313	Table I all conditions	Intended use: fabrication of springs and cowl pins. Condition B obtained by cold working and not by heat treatment.
303 303 Se	Bar, Forgings, Wire (sol. treated), Forgings stock Bar, Forgings (sol. treated) (swaging and hot upsetting), Forging stock Bar, (cold drawn) Bolting Casting Bar, Forgings (sol. treated) Forging stock (Cr & Ta stabilized) Bar, Forgings (sol. treated) Forging Stock (Pb added)	AMS 5640J ASTM-A581, 582, 473 & 314 AMS 5641A AMS 5738 ASTM-A194, A320 ASTM-A296 AMS 5642 AMS 5642C AMS 5635	Table I for all conditions	18-8 type stainless steel. Sulphur or selenium added to improve machining. Limited to service temperatures below 371°C (700°F). 303 Se is superior to type 303 in corrosion resistance. Welding not recommended; fusion welding with type 310 electrodes possible. Inferior to 304 in corrosion resistance.
304 304 L	Sheet, Strip, Plate (sol. treated) Tubing, seamless (sol. treated) Bar, Forgings, Tubing (sol. treated) Wire (sol. treated) (cold drawn) Sheet, Strip, Plate (sol. treated) Bar, Forgings, Tubing (sol. treated) Tubing	MIL-S-5059 MIL-T-8506 QQ-S-763, A580 ASTM A-313 MIL-S-4043 QQ-S-763 BS506334	Table I all conditions including 304L weldments	Similar properties to 302 but corrosion resistance is slightly higher because of lower carbon content and increased chromium and nickel. Use 304L where welding is required. Used for bolts, springs.
310S 310	Sheet, Strip, Plate Bars, Forgings, Tubing Wire, Welding	QQ-S-763 MIL-S-7720 AMS 5521 QQ-S-763 AMS 5651 MIL-S-7720 MIL-R-5031 C13	Table I all conditions	Has more chromium and nickel than 18-8 family. 310 has 0.25% carbon; 310S has 0.08% maximum carbon. Intended for high temperature applications; highest strength and corrosion resistance. Subject to intergranular carbide precipitation in the temperature range of 427° to 871°C (800° to 1600°F).

* Heat affected zone

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-12. STEEL, STAINLESS, AUSTENITIC (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
316, 316L	Sheet, Strip, Plate Bars, Shapes, Forgings Pipe, Tube Wire	QQ-S-766 MIL-S-5059 QQ-S-763 MIL-S-7720 MIL-T-1144 AMS 5690 ASTM-A313, -A580	Table I all conditions including 316L weldments.	Molybdenum (Mo) provides marked improvement in corrosion resistance and elevated-temperature strength over non-bearing Mo stainless steel. Usable strength up to 815°C (1500°F). Annealed condition has excellent formability. Can be used in nitric acid environment.
321	Sheet, Strip, Plate Billets, Bars, Forgings Tube, Pipe Wire	QQ-S-766 MIL-S-766 QQ-S-763 MIL-T-6737 BS506334 AMS 5689	Table I all conditions; includes weldments	Similar to 304 except that Ti is added to form stable precipitates of Ti carbide. Can withstand 427° to 871°C (800° to 1600°F) and prolonged service. Used for exhaust manifold expansion joints, high temperature applications.
347	Sheet, Plate, Strip Bar, Shapes, Forgings Tubing	QQ-S-766 QQ-S-763 BS506334	Table I all conditions; includes weldments	Stabilized by Cb plus tantalum. Resistance to sensitization—reduction in intergranular corrosion. Used for long duration service; 427° to 815°C (800° to 1500°F). Designed for nuclear applications; compatible with solid rocket motor propellants.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-13. STEEL, STAINLESS, FERRITIC

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
410	Sheet, Strip, Plate Bar, Shapes, Forgings	QQ-S-766 QQ-S-763	Table II (See comments)	Air hardening SS corrosion resistance is inferior to 300 grades. Highest strength conditions are susceptible to stress corrosion cracking (SCC). High silicon 410 application in wrought forms and sand castings; 410 intended for structural applications where corrosive environment is not severe; maximum service temperature in air is 815°C (1500°F); continuous is 704°C (1300°F); welding results in hardening and embrittlement. Heat treatment required. Used for springs, pivots, fasteners.
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Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-14. STEEL, STAINLESS, MARTENSITIC

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
430	Sheet, Strip, Plate Bar, Shapes, Forgings	QQ-S-766 QQ-S-763	Table I all conditions	General purpose; intended for structural parts where corrosive conditions are not too severe. Ferromagnetic; good oxidizing resistance. Has good ductility and formability. High temperature strength relatively poor compared to austenitic grades. Toughness limited at low temperature and in heavy sections. When exposed to temperature of 370 to 540°C (700 to 1000°F), precipitation results in increased hardness and drastic reduction in room temperature toughness. More desirable than austenitic steels; has improved thermal-fatigue resistance.
440 A 440 C	Bars, Shapes, Forgings, Wire	QQ-S-763 AMS 5631	Table II for 440A Table III for 440C (See comments)	Use where high wear and corrosion resistance is required. Contains 0.75 percent Mo; difficult to machine; special welding required. Used in hardened condition for high wear and corrosion resistance. Tempering between 372 and 593°C (700 and 1100°F) shall be avoided. Subject to severe hydrogen embrittlement by gaseous hydrogen; Used for ball bearing races, balls, bushings, and valves.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-15. TITANIUM ALLOYS*

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Ti-3Al-2.5 V	Tubing, Seamless and Welded, Annealed and CW Stress Relieved	ANSI/ASTM B337	Table I all conditions	Principally used as tubing in aircraft and jet engine hydraulic systems, and as foil for honeycomb panels. Alloy offers 20 to 50% higher tensile strength than the strongest commercially pure grade of titanium at both room temperature and elevated temperatures. Can be procured from Tubesales, Grand Prairie, TX.
	Tubing, Seamless, CW and Stress Relieved	AMS 4944	Table I all conditions	
	Tubing, Seamless, Annealed	AMS 4943	Table I all conditions	
	Sheet, Strip and Foil, Annealed	GE B50TF117-S3	Table I all conditions	
	Welding Rods and Electrodes, Bare	AWS A5.16	Table I all conditions	
	Bars, (Rolled or Forged) and Reforging Stock	MIL-T-9047	Table I all conditions	
Ti-5Al-2.5 Sn	Sheet, Strip, Plate Bar, Forgings	MIL-T-9046 AMS 4910A MIL-T-9047 AMS 4966	Table I all conditions	Medium strength alpha titanium alloy having high fracture toughness at room temperature and elevated temperature. Fusion weld strength is equal to parent metal. Explosion hazard if in contact with LOX or gaseous oxygen at pressures above 345 kPa (50 psi). Also available in high purity extra-low-interstitial (ELI) grade. Impurity content designed for cryogenic usage where high toughness is required. Alloy is single phase alpha type; oxidation resistance to 538°C (1000°F).
Ti-6Al-4V	Sheet, Strip, Plate Bars, Forgings, Rings, Wire, weldable	MIL-T-9046; AMS 4906 MIL-T-9047 AMS 4954 FS509333**	Table I all conditions	An alpha-beta Ti composition. Use up to 400°C (750°F). High strength obtained at cryogenic conditions. Fracture toughness below -159°C (-250°F) poor for the fully heat treated condition; improved properties using ELI grades and beta processing; oxidation resistance to 540°C (1000°F). Prefer forming in annealed condition. Weldable by electron beam, plasma arc, friction and diffusion welding, inert gas shielded tungsten arc.

* The thermal conductivity of titanium is much lower compared to other metals. For example, copper conductivity is 47 times greater than Ti alloy 6Al-4V and 23 times greater than unalloyed Ti. Aluminum (1100) is 25 times greater and steel (301) is 2 times greater in thermal conductivity than titanium.

** Pressure vessels, heat treated titanium alloy (Ti-6Al-4V, STA) flight equipment.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-15. TITANIUM ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Ti-13V-11Cr-3Al (B120 VCA)	Sheet, Strip, Plate Bars, Forgings	MIL-T-9046 BS506307 MIL-T-9047	Table I all conditions	Heat treatable beta alloy with good workability and toughness in the annealed condition and high strength in the heat treated condition. Used for structural applications. Weldable by electron beam, plasma arc, friction and diffusion welding, inert gas shielded tungsten arc.
Ti-CP-1 (Ti-CP-70)	Sheet, Strip, Plate Bar Wire Tubing	MIL-T-9046 MIL-T-9047 AMS 4951	Table I all conditions	Tensile yield-485 MPa (70 ksi) minimum for commercially pure sheet grade; readily formable at room temperature. Used for spacecraft frame and structures; beta transus 949°C (1740°F); good oxide resistance to 538°C (1000°F).
Ti-CP-2	Sheet, Strip, Plate Wire, Welding Tubing	AMS 4900; MIL-T-9046 AMS 4951	Table I all conditions	Tensile yield-380 MPa (55 ksi) minimum; formable at room temperature. Used for spacecraft frames and skins, and where maximum formability is required. Beta transus about 918°C (1675°F). Completely weldable. Good oxide resistance to 427°C (800°F) (air).
Ti-CP-3	Sheet, Strip, Plate Wire, Welding Tubing	AMS 4902A MIL-T-9046 AMS 4951 AMS 4941	Table I all conditions	Tensile yield-275 MPa (40 ksi) minimum; commercially pure grade. Used where high ductility and formability are required; beta transus about 888°C (1630°F). Part use up to 204°C (400°F); good oxide resistance.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS*

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
B E R Y L L I U M	<p>General: Beryllium is one of the lightest structural metals known. Density is 1.85 g/cm³ (0.067 lb/in³). Possesses high modulus to density ratio, good strength to density ratio, high specific heat and good thermal conductivity. Metal is brittle in nature and has low fracture toughness. Useful strength up to 593°C (1100°F). Blocks produced from Be powder. Wrought forms produced by reworking hot-pressed block. Machineable; can be rolled, drawn or extruded, chemically milled, or electrical discharge machined (EDM). Can be adhesively bonded or brazed (fusion welding not recommended). Surface protection required; resort to passivation, chromate conv. coating and anodizing; can be plated. Used for nuclear reactors, infrared target acquisition systems, inertial guidance instrumentation, aircraft disc brakes, audio components, high speed computer parts, satellite structures, heat sink cores for surface mounted electronic circuits, cryogenics and optical mirrors.</p>			
	Vacuum hot-pressed block (HPB) Sheet and Plate (Structural Grade)	AMS 7902 MIL-B-8964 MIL-B-21531	A Rating	40% of tensile strength to density ratios maintained at 649°C (1200°F) for wrought and HPB.
	Block (Nuclear Grade)	S-65 A; S-65 B S-200 C; S-200 F	Table I annealed condition	Has high transparency to x-rays and high neutron flux and scattering x-section.
	Block (Instrument Grade)	AMS 7907 I-220 B; I-250; I-400	A Rating	Developed where high micro-yield strength is required. I-250 offers 40% greater strength. Grades I-220 and I-400 remain the standards.
	Block (Optical Grade)	AMS 7905 0-50; I-70 B; I-220 B S-200F	A Rating	0-50 developed as an improvement over I-70B as the standard for polished beryllium optics. I-220 and I-250 used where optical surface is a hard polished electroless nickel.
	Foil (Wrought Form)	IF-1; PF-60	A Rating	Flat stock with thickness of 0.508 mm (0.020 inch) or less. Used in windows transmitting different wavelengths of radiation. IF-1 is highest purity material in thicknesses between 0.008 mm (0.0003 inch) and 0.508 mm (0.020 inch). PF-60 is available between 0.008 mm (0.0003 inch) and 3.175 mm (0.125 inch).

* All S, I, IF, PF, SR and PR designations are Brush-Wellman.

WARNING: Beryllium particulates present a health hazard. Special precautions in machining and handling required.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
B E R Y L L I U M	Plate and Sheet	SR-200 E PR-200 E AMS-7902	A Rating	<u>Wrought forms (cont'd):</u> Beryllium rolled stock; gauge between 0.508 mm (0.020 inch) and 6.35 mm (0.250 inch). Thickness greater than 6.35 mm (0.250 inch).
	Near net shapes	S-200 FH S-200 FC	A Rating	Standard Grade; produced by hot isostatic pressing (HIP) and cold isostatic pressing (CIP). Mechanical properties better than hot pressed material. 0-50 and I-250 can also be used.
	Rod and Tubing	I-250	A Rating	Rod sizes from 0.953 cm (0.375 inch) to 14.605 cm (5.75 inches); tubing from 635 mm (0.250 inch) OD by 0.015 mm (0.029 inch). Wall thickness to 101.6 mm (4.0 inches) OD by 635 mm (0.250 inch) wall thickness. Use where combination of high strength-to-weight ratio, high micro-yield strength, high modulus of elasticity, and excellent dimensional stability is required.
	Bars, Rods, Tubing and Shapes (High Micro-yield Strength)	AMS 7903	A Rating	For parts requiring high strength-to-weight ratio, high micro-yield strength, high modulus of elasticity and excellent dimensional stability.
	Bars, Rods, Tubing and Shapes (High Ductility Grade)	AMS 7904		For parts requiring a combination of high strength-to-weight ratio, high modulus of elasticity and high ductility.
	Bars, Rods, Tubing and Shapes (Optical Grade)	AMS 7905		<u>Optical Grade</u> - For parts requiring a high strength-to-weight ratio, high modulus of elasticity, high density, low oxide content and good polishing characteristics.

WARNING: Beryllium particulates present a health hazard. Special precautions in machining and handling required.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Beryllium	Bars, Rods, Tubing and Shapes (Standard Grade)	AMS 7906	A Rating	<u>Standard Grade</u> - For parts requiring a combination of high strength-to-weight ratio and high modulus of elasticity.
	Bars, Rods, Tubing and Shapes (Instrument Grade)	AMS 7907		<u>Instrument Grade</u> - For parts requiring a combination of high strength-to-weight ratio, high modulus of elasticity, excellent dimensional stability, and minimum guaranteed micro-yield strength.

WARNING: Beryllium particulates present a health hazard. Special precautions in machining and handling required.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
4-79 ⁽²⁾ Moly Perm-alloy HyMu 80 ⁽¹⁾ Perm-alloy 80 ⁽³⁾	Thin foil Tape, Toroidal Cores Sheet, Strip	MIL-N-47037 (MI) SAE/AMS 7701 MIL-N-14411 ASTM A-753 —**	—*	79 Ni-4 Mo alloy-magnetic shielding for electronic components; cores for computers and radar pulse transformers; also used for strip laminations, and magnetic amplifier coils requiring extremely high permeability and minimum hysteresis loss. Good corrosion resistance. Also see Tables 1 and 2 on page 3.1-31.
HyMu 77 ⁽¹⁾ Mu-metal ^(2,3)	Thin foil Tape, Toroidal Cores Sheet, Strip, Bar Forgings	MIL-N-47037 (MI) AMS 7701, ASTM A848 AMS 7905	—*	77 Ni-5Cu-2Cr: magnetic shielding for electronic components shields; special choke coils and transformers for audio and carrier circuits. Very high permeability, low losses. Also see Tables 1 and 2 on page 3.1-31.
High Permeability 49 ⁽¹⁾ Alloy 48 ⁽³⁾	Sheet, Strip Foil	—**	—*	49Ni-Fe: magnetic shielding for electronic components shields; audio chokes and transformers; relays; pole pieces for communication use. Also see Tables 1 and 2 on page 3.1-31.
2V Permen-dur ⁽²⁾ Permen-dur V ⁽³⁾ Hiperco 50 50A ⁽¹⁾	Sheet, Strip Foil	—**	—*	2V-49Co-49Fe: magnetic shielding for electronic components such as pole tips, magnetic yokes, and electromagnets; high permeability at very high flux densities. Also see Tables 1 and 2 on page 3.1-31.

(1) Carpenter Technology Corp.

(2) Allegheny Ludlum Corp.

(3) Spang & Company, Specialty Metals Division.

*Stress corrosion rating undetermined and could not be found.

**Specification rating could not be found.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)
(IRON-COBALT AND NICKEL-IRON ALLOYS)

TABLE 1*

Domestic producers of nickel-iron and iron-cobalt magnetically soft alloys. See Table 2 for applications.

Alloy	TRADE NAMES			
	Carpenter Technology Corporation	Allegheny Ludlum Corporation	AlTech	Spang & Company Specialty Metals Div.
45 to 49 Ni-Fe Square loop 49 Ni-Fe 45 Ni-3 Mo-Fe 77 Ni-5 Cu-2 Cr-Fe 79 Ni-4 Mo-Fe	High permeability 49 HyRa 49 ... HyMu 77 HyMu 80, HyMu 800 HyMu 80 Mark II Hipernom	4750 Delta Max Monimax MuMetal 4-79 Permalloy	4750	Alloy 48 Orthonol ... MuMetal Permalloy 80
2V-49 Co-49 Fe 27 Co-0.6 Cr-Fe 30 to 32 Ni-Fe	Hiperco 50 and 50A Hiperco 27 Temperature compensator	2V Permendur	Permendur V ...

TABLE 2*

Application of nickel-iron and iron-cobalt magnetically soft alloys.

Application	Specialty alloy	Special property
Instrument transformer	79 Ni-4Mo-Fe, 77Ni-5Cu-2Cr-Fe, 49Ni-Fe	High permeability, low noise and losses
Audio transformer	79 Ni-4Mo-Fe, 49Ni-Fe, 45Ni-Fe, 45Ni-3Mo-Fe	High permeability, low noise and losses transformer grade
Hearing aid transformers	79Ni-4Mo-Fe	High initial permeability, low losses
Radar pulse transformers	2V-49Co-49Fe, oriented 49Ni-Fe 79Ni-4Mo-Fe, 45Ni-3Mo-Fe	Processed for square hysteresis loop, tape toroidal cores
Magnetic amplifiers	Oriented 49Ni-Fe, 79Ni-4Mo-Fe	Processed for square hysteresis loop, tape toroidal cores
Transducers	2V-49Co-49Fe, 45-50Ni-Fe	High saturation magnetostriction
Shielding	79Ni-4Mo-Fe, 77Ni-5Cu-2Cr-Fe, 49Ni-Fe	High permeability at low induction levels
Ground fault (GFI) interruptor core	79Ni-4Mo-Fe	High permeability, temperature stability
Sensitive dc relays	45 to 49Ni-Fe, 78.5Ni-Fe	High permeability, low losses, low coercive force
Electromagnet pole tips	2V-49Co-49Fe, 27Co-0.6Cr-Fe	High saturation induction
Tape recorder head laminations	79Ni-5Mo-Fe	High permeability, low losses (0.05 to 0.03 mm (0.002 to 0.001 in.))
Telephone diaphragm armature	2V-49Co-49Fe	High incremental permeability
Temperature compensator	29 to 36Ni-Fe	Low Curie temperature
High-output power generators	2V-49Co-49Fe, 27Co-0.6Cr-Fe	High saturation
Dry reed magnetic switches	51Ni-Fe	Controlled expansion glass/metal sealing
Chart recorder (instrument) motors, synchronous motors	49Ni-Fe	Moderate saturation, low losses, nonoriented grade
Loading coils	81-2 brittle Moly-Permalloy	Constant permeability with changing temperature

* Metals Handbook, 10th Edition, Volume 2, Special Purpose Materials, 1990.

Materials with either Table I or "A" rating are preferred.

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Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)

ALLOY DESIG- NATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Elgiloy ⁽¹⁾ 40Co 20Cr 15Ni 15Fe 7Mo 2Mn 1Rem	Round Wire (Form A) Strip (Form b) Rod, Sheet	BS502537	A rating	Cobalt-Nickel alloy having excellent corrosion resistance. Non-magnetic through all temperature ranges. Used for coils and springs, drive bands, torsion bars, ball bearings and cables. High resistance to fatigue; can be spot welded, laser electron beam and heliarc welded; used on Viking HGA.
INVAR 36 ⁽²⁾⁽³⁾ 36 Ni- 64Fe (special low expan- sion, low carbon)	Strip: cold rolled, annealed Wire: Cold drawn, annealed Bars: hot rolled, cold drawn centerless ground, annealed flats, squares Rod, Plate, Shapes, Sheet Hot isostatic press	BS506336	Table I all conditions	Ni-Fe alloy. Low thermal expansion characteristics up to 204°C (400°F). If lowest expansion is required, bars should be ordered cold drawn, annealed and quenched, or quenched and stabilized. Used where dimensional change due to temperature variations must be minimal.
INVAR 36 ⁽²⁾⁽³⁾ (free- cutting)(Ni- Co-Se-Fe)	Wire: cold drawn, annealed Bars: Hot rolled, cold drawn centerless ground, annealed flats, Squares Billets	MIL-S-16598	Table I all conditions	Free machining 36% Ni-Co-Fe alloy, low thermal expansion same characteristics as Invar 36 above. Used in PWB's; can be welded by conventional methods; may be swaged or cold upset. No unusual problems in blanking and forming.
Super- INVAR (2)(3) Ni-Co5-Fe low expansion alloy	Bar	BS 504204	—*	Low expansion alloy-CTE smaller than INVAR over a narrower temperature range. Used for guidable tape, bimetal strip, glass-to-metal seals, electronic components, structural components for optical and laser measurement systems.
KOVAR ⁽³⁾ (Nico seal) 54Fe- 29Ni- 17Co	Sheet, Strip, Tape Bar, Forgings Wire Lead wire (Type K)	AMS 7728 AMS 7727 AMS 7726 MIL-STD-1276	"A" rating	Low expansion glass sealing alloy used for lids and closures for hybrid electronic packages. CTE closely matches those of standard types of borosilicate glass. Used for lead wire to hard glass seals for electronic components.

(1) Elgiloy Company

(2) Inco Alloys Intl.

(3) Carpenter Technology

*Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

Section 3.1 METALLIC MATERIALS (Cont'd)

Table 3.1-16. SPECIAL PURPOSE ALLOYS (Cont'd)

ALLOY DESIGNATION	FORM	MATERIAL SPECIFICATION	STRESS CORROSION RATING	COMMENTS
Magnetic Iron Mu metal ⁽¹⁾ Hy Mu 77 ⁽²⁾ 77Ni-5Co-2Cr-Fe	Bar, Sheet, Strip, Forgings	MIL-I-11695 AMS 7701 AMS 7905	—*	Intended for use as pole pieces, plates, armatures, core material, magnetic circuits requiring high magnetic permeability at low flux densities after high temperature annealing in hydrogen. Also used for instrument transformers and magnetic shielding; similar to 4-79 molypermalloy.
Ni-Span-C ⁽³⁾ Alloy 902 42 Ni-Cr5-Ti-2.5-Fe	Strip Sol heat treat Cold rolled 10% reduction Cold rolled 50% reduction (available as a product of a heat)	AMS 5221 AMS 5223 AMS 5225	—*	Fe-Ni-Cr alloy. Controllable thermoelastic coefficient (rate of change of modulus of elasticity with change in temperature). Constant modulus of elasticity from -46° to 66°C (-50° to 150°F) in alloy 901. Used where elasticity members are subject to temperature fluctuations. Used for diaphragms, leaf springs, helical springs, wire springs, delay lines, requiring a precipitation-hardenable alloy after suitable heat treatment.
Therm-alloy Aluminum 1100 Copper 102 C-10200	Plate, Sheet, Strip Plate, Sheet, Strip	QQ-A-250/1 ASTM B209 ASTM B152 AMS 4501	Table I for all conditions A Rating	Used as heat sink for microelectronic devices, semiconductor accessories, insulation and mounting pads. Procured from Thermalloy, Inc. Material type and specification shall be called out.

(1) Allegheny Ludlum

(2) Carpenter Steel

(3) Inco Alloys Intl.

*Stress corrosion rating undetermined and could not be found.

Materials with either Table I or "A" rating are preferred.

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Section 3.2 - Nonmetallic Materials

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SECTION 3.2 MATERIALS-NONMETALLIC

THE FOLLOWING NOTES PERTAINING TO OUTGASSING AND FLAMMABILITY ARE REFERENCED IN THE "COMMENTS" COLUMN FOR EACH NONMETALLIC MATERIAL AS APPLICABLE.

OUTGASSING*

- Note A1. Meets the requirements of JSC SP-R-0022A (TML 1.0% max.; VCM 0.10% max.).
- Note A2. Can be made to meet the requirements of SP-R-0022A by special processing (oven bake, thermal vacuum bake, etc.)
- Note A3. Can be made to meet the requirements of SP-R-0022A by overcoating with a low volatility coating.
- Note A4. Does not meet the requirements of SP-R-0022A.
- Note A5. Does not meet the requirements of SP-R-0022A, but is normally used in very small quantities.
- Note A6. No data.

FLAMMABILITY*

- Note B1. Non-flammable.
- Note B2. Self-extinguishing in an air atmosphere, but will sustain combustion in an oxygen-enriched atmosphere.
- Note B3. Will sustain combustion in an air atmosphere.
- Note B4. No data.

See Appendix A for an index of codes assigned to manufacturers referenced in the "MFG" Column.

See Appendix B for an alphabetical index by "Designation" of nonmetallic materials.

See Appendix C for a numerical index of nonmetallic material specifications

*Thermal vacuum stability and flammability classified in accordance with MSFC HDBK 527 F/JSC 09604F

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-1. ADHESIVE PRIMERS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
BR 127	ACYa	BS506302	Modified epoxy phenolic, corrosion inhibiting primer supplied as a 10%-solids, yellow liquid. Use with Bloomingdale adhesives including FM 24, FM 73, FM 123-2, FM 123-LVC and FM 300 in the bonding of aluminum, magnesium, steel and titanium alloys. Requires air drying for 30 minutes minimum and curing for 60 minutes at 121°C(250°F). <u>Note A1.</u>
EA 9205	HYS	BS513278	Corrosion inhibiting primer supplied as a 20%-solids, blue-green liquid. For long time service at 177°C(350°F) and intermittent service at 215°C(420°F). Use with Hysol EA 9649R and EA 9667 adhesive films in the bonding of aluminum, magnesium, steel and titanium alloys in applications in which more heat resistant bonds are required. Requires air drying for 30-60 minutes and oven curing for 60 minutes at 177°C(350°F). <u>Note A1.</u>
EA 9210	HYS	BS506330	Epoxy based, corrosion inhibiting primer supplied as a 10%-solids, greenish yellow liquid. Use with most epoxy adhesives manufactured by Hysol in the bonding of aluminum, magnesium, steel and titanium alloys. Requires air drying for 30 minutes and curing for 60-90 minutes at 127°C(260°F). Apply per FS509336. <u>Note A1.</u>
EC-2320	MMMa	BS502555	Sprayable structural adhesive primer supplied as a 5%-solids, blue liquid. Use with Scotch-Weld 2216 B/A and Scotch-Weld film adhesives in the bonding of aluminum, magnesium, steel and titanium alloys. May be dried from 24° to 121°C(75° to 250°F). <u>Note A5.</u>
FM 47, Liquid	ACYa	BS502693	A one-part system consisting of a vinyl-phenolic adhesive in a solvent. Use as primer for FM 47 adhesive films on metal facing and honeycomb core. Use alone as a metal-to-metal adhesive where a liquid adhesive is preferred. Requires cure with FM47 film for 2 hours at 177°C(350°F) at pressure of 0.10 to 3.45 MPa (15 to 500 psi). 1.38 MPa (200 psi) generally recommended. <u>Note A3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-1. ADHESIVE PRIMERS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
HT 424 Primer	ACYa	— *	An unfilled epoxy-phenolic <u>two-part</u> primer A and B for use with HT 424 and HT 432 tape adhesives. Improves peel strength and maintains metal cleanliness during production operations. <u>Note A2.</u>
HT 424F Primer	ACYa	— *	A filled epoxy-phenolic <u>one-part</u> primer for use with HT 424 and HT 424F tape adhesive. Improves peel strength and maintains cleanliness during production operations. <u>Note A2.</u>
3M 3900	MMM	TBD	TBD
PR-420 A/B	PRC	BS502682	A two-part polyurethane primer which cures to a tough coating with excellent adhesion to aluminum, sandblasted steel, and other metallic surfaces. Primer is used for potting and molding compounds. Must be applied within the times specified in the PRC directives. Initial curing of PR-420 is accomplished primarily by solvent evaporation at room temperature. <u>Note A6.</u>
SS 4004	GECb	BS502512	Silicone rubber primer supplied as 15%-solids fluorescent pink liquid. Use with RTV 11 through 88, RTV 500 Series and RTV 8000 Series. Dry at room temperature. Note: Ultraviolet radiation resistant coating. (See D-8208, Section 3.18). <u>Note A3.</u>
SS 4044	GECb	BS502524	Silicone rubber primer supplied as a 15%-solids, clear, colorless liquid. Use with RTV 11 through 88, RTV 500 Series and RTV 8000 Series. Dry at room temperature. <u>Note A3.</u>
SS 4155	GECb	BS504185	Silicone rubber primer supplied as a 10%-solids, blue liquid. Use with RTV 11 through 88, RTV 500 Series, RTV 615, 616, 627, 630, 655, 670 and 6159. Dry at room temperature. <u>Note A3.</u>
Sylgard Primer	DCC	BS506314	Silicone primer, supplied as a 2%-solids, clear liquid. Use with Dow Corning Sylgard 182 and 184 and DC 93-500 encapsulating resins. Dry at room temperature or at temperatures up to 70°C(158°F). <u>Note A6.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-2. ADHESIVE NONSTRUCTURAL

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
A-31 A/B	MTI	—*	A two-part, room temperature curing, thixotropic epoxy for general purpose applications, recommended for staking and spot bonding where flow during cure cannot be tolerated. Pot life is 40 minutes. Useful as a nonstructural adhesive. <u>Note A1.</u>
Abletherm 12-1	ABL	BS515843	A highly filled (MgO) thermally conductive silicone adhesive designed for bonding applications which require high thermal conductivity and repairability - such as flatpack to heat sink bonds. Supplied in frozen squeeze tubes stored at -40°C(-40°F). Can be cured at various temperatures: 4 hr at 65°C(150°F); can withstand temperatures up to 200°C(392°F). <u>Note A1.</u>
DC 6-1104	DCC	BS506319	Moderate viscosity, non-slumping, translucent white, one-part silicone rubber. Used as an adhesive/sealant. Controlled volatility. Cures at room temperature. Used for bonding, sealing and encapsulating electrical/electronic wires and terminals, and mounting resistors and connectors on electronic and optical assemblies. See D-8208, Section 3.18. <u>Note A1.</u>
DC 93-500	DCC	BS504221	Pourable, transparent, two-part silicone rubber. Used as a solar cell cover glass adhesive and for potting and encapsulating electronic equipment. Controlled volatility. Cures at room temperature or elevated temperature 65°C(149°F). Service temperature range: -65° to 200°C(-85° to 392°F). <u>Note A1.</u>
Eccobond 55/9	ECI	BS502501	Printed wiring board bonding; medium viscosity, transparent, amber, general purpose, rigid epoxy adhesive. Use for bonding of small electrical components and circuit boards. Also bonds glass, ceramics, metals and plastics; use for hermetic sealing. Use per D-8208, Section 3.18. Can be cured at room temperature. Service temperature: -57 to 149°C(-70 to 300°F). Lower outgassing obtained with 55°C(131°F) cure. <u>Note A1.</u>
Eccobond 56C/9	ECI	BS502539	Thermally and electrically conductive material. Silver-filled epoxy paste adhesive used for rigid conductive bond in making electrical connections in those cases in which hot soldering is not practical. Requires at total cure of 16 hours at 52°C(125°F) before flight. See D-8208, Section 3.18. Service temperature: -57 to 177°C(-70 to 350°F). <u>Note A1.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-2. ADHESIVE NONSTRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Eccobond 57C A/B	ECI	BS502572	Thermally and electrically conductive material. Silver-filled epoxy paste adhesive used for semi-rigid conductive bond in making electrical connections in those cases in which hot soldering is not practical. Used also for temperature transducer bonding. See D-8208 Section 3.18. Requires a total cure of 16 hours at 52°C(125°F) before flight. Service temperature: -57 to 177°C(-70 to 350°F). <u>Note A1.</u>
Eccobond 66C/9	ECI	BS515841	Silver filled epoxy paste adhesive used for semi-rigid conductive bond in making electrical connections in which hot soldering is not practical. Requires room temperature cure for 24 hours before flight or 2 hours at 49°C(120°F). Used to ground surface mount components as well as to accommodate differences in tolerance of board cutouts. Service temperature: -57 to 177°C(-70 to 350°F). <u>Note A1.</u>
Eccobond 285	ECI	— *	A two-component room temperature curing, thermally conductive, thixotropic epoxy for general purpose adhesive bonding. Has choice of 3 catalysts depending on service temperature desired. For 121°C(250°F) use catalyst 24LV; for 149°C(300°F) use catalyst 9; for 177°C(350°F) use catalyst 11. <u>Note A1.</u>
Epon 828 Versamid 125	SCA HKL	BS502506 BS502507	Medium viscosity, general purpose flexibilized epoxy adhesive, translucent amber. Use for bonding electronic parts such as relays and small inductors. Use per ZPS-4013-0025. Cure from room temperature to 93°C(200°F). Can also be used as a surface coating, or as a laminating, casting and potting compound. <u>Note A1.</u>
Epon 828 Versamid 140	SCA HKL	BS502506 BS505785	Medium viscosity, general purpose flexibilized epoxy adhesive, translucent amber. Use for bonding electronic parts such as relays and small inductors. Use per FS513166. Cure from room temperature to 93°C(200°F). <u>Note A1.</u>
Epotek H20E	ETI	SAE/AMS 3681	Silver-filled epoxy conductive adhesive for microelectronic devices. Operating service temperature: 175°C(347°F); intermittent for 5 minutes at 300°C(572°F). <u>Notes A1 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-2. ADHESIVE NONSTRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Epotek H74 A/B	ETI	— *	A two-part low temperature cure, 100% solids tan epoxy. Use as a thermally conductive adhesive for bonding integrated circuit (IC) packages to large substrates. Cure at 50°C(122°F). Will change colors up to a dark red depending upon temperatures of exposure. Tolerates temperature of 300° to 400°C(570° to 750°F) for a brief duration. (Similar to Eccobond 55/9.) <u>Notes A1 and B3.</u>
Epotek 353 ND	ETI	— *	Epoxy adhesive for bonding terminating fiber optic bundles. Operating service temperature: 175°C(347°F); intermittent for 5 minutes 300°C(572°F). <u>Notes A1 and B3.</u>
3 P Adhesive	SHD	Sheldahl P/N A016300	Polyimide/polyamide/polyester adhesive used for bonding fabrics to carbon-filled Kapton. Has extremely high temperature resistance up to 315°C(600°F) for short time periods. <u>Notes A1 and B1.</u>
PLV 2000	PEL	BS513522	A Viton fluoroelastomer two-component liquid system consisting of a base liquid and an accelerator. Use for bonding Viton fluoroelastomer rubber to itself or other materials. Use per FS513523. Cure at 104°C(220°F). <u>Note A4.</u>
RTV 566 A/B	GEC _b	BS504228	Moderate viscosity, controlled volatility, two-part, opaque (red) silicone rubber. Use as solar cell adhesive and as encapsulant. Use per FS509330. Cure at room temperature. Service temperature: -57 to 260°C(-70 to 500°F). <u>Notes A1.</u>
Solithane** 113/C113-300	UNC	BS502695 (resin & catalyst)	Moderate viscosity, filled, translucent urethane resin. Use as vibration damping support to strain-sensitive electronic parts such as ICs and glass body resistors, and to support mounted electronic components. Also used in electronic component bonding. See D-8208, Section 3.18. Service temperature not to exceed 93°C(200°F). <u>Note A1.</u>
Colloidal Silica (CAB-O-SIL M-5)	CAB	BS502697 (filler)	
Catalyst Thermolite 12	GEC _b	BS502698 (accelerator)	

*Specification could not be found.

**For applications below -5°C(23°F) see Materials or Packaging Engineers.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-2. ADHESIVE NONSTRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Solithane* 113 Catalyst C113-300	UNC	BS502695 (resin & catalyst)	Used for printed wiring board bonding and for potting of subassembly mounted connectors. Use per D-8208, Section 3.18. <u>Note A1.</u>
Tri-Isopropanol-Amine (TIPA)	DOW	BS506323 (catalyst)	
Thermolite 12	GEC _o	BS502698 (accelerator)	
Solithane* 113 Catalyst C113-300	UNC	BS502695	Temperature transducer bonding; flexible transparent polyurethane resin; used for conformal coating of electronic parts and mounting surfaces. See D-8208, Section 3.18. <u>Note A1.</u>
Thermolite 12	GEC _o	BS502698 (accelerator)	
Stycast 2850FT/11	ECI	BS506311	Two-component thermally conductive epoxy casting resin. Highly filled, viscous, black, rigid epoxy. Use for spot bonding of temperature transducers. Has good thermal conductivity and low shrinkage. Requires oven cure at 65°C(150°F) for optimum properties and low vacuum outgassing. <u>Note A1.</u>
Stycast 2850FT/24LV	ECI	BS513151	Two-part, 100-percent solids, room temperature curing, epoxy resin. Use for spot bonding electronic components and cabling. Has high thermal conductivity and low thermal expansion. Operational service temperatures from -270° to 120°C(-454° to 248°F). <u>Note A1.</u>

*For applications below -5°C(23°F) see Materials or Packaging Engineers.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-3. ADHESIVES, STRUCTURAL

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
EA 901NA/B-1 *	HYS	BS502545	High viscosity, thixotropic, opaque, red, rigid epoxy. Use for general purpose structural bonding. Use as temperature transducer bonding per D-8208, Section 3.18. Use per ZPS-4071-0001. Requires one-hour cure at 93°C(200°F) for low vacuum outgassing. Service temperature is from -57 to 93°C(-70 to 200°F). <u>Note A4.</u>
EA 901NA/L-3	HYS	BS506304	High viscosity, thixotropic, opaque, gray, rigid epoxy. Use for high temperature application. Good for bonding copper-etched teflon. Use per ZPS-4071-0002. Requires a 30-minute cure at 116°C(240°F) followed by a 90-minute cure at 177°C(350°F). Service temperature is from -57 to 177°C(-70 to 350°F). <u>Note A6.</u>
EA 907 A/B	HYS	BS513317	Two-part, 100-percent solids, general purpose structural epoxy adhesive. Adheres well to a variety of surfaces and is tolerant of poorly prepared surfaces. Not recommended for applications requiring low outgassing adhesive. Can be cured at any temperature between room temperature and 121°C(250°F). Service temperature is from -57 to 121°C(-70 to 250°F). <u>Note A4.</u>
EA 913/L-3	HYS	BS502530	High viscosity, opaque, gray, semi-rigid epoxy. Gives relatively high strength bonds. Use per ZPS-4071-0005. Requires 3-hour cure at 82°C(180°F). Good adhesion to Buna-N rubber. Service temperature is from -57 to 82°C(-70 to 180°F). <u>Note A4.</u>
EA 934NA A/B	HYS	BS515055	A two-part structural thixotropic asbestos-free epoxy-polyamide adhesive. Replaces EA 934 A/B; room temperature cure designed for high temperature properties. Also used for potting, filling, and liquid shim applications. Contains filler (silica and aluminum powder). Bonds metals, plastics, rubber and glass. Service temperature is from -55 to 177°C(-63 to 350°F). <u>Notes A1 and B1.</u>
EA 934NA/ EA 956 Blend	HYS	BS513988	Moderate viscosity, opaque, gray, semi-rigid epoxy-polyamide adhesive for elevated temperature use. Cure at room temperature. Useful for applications requiring thin bond lines. Service temperature is from -57 to 149°C(-70 to 300°F). <u>Note A1.</u>

*NA (Non-Asbestos)

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-3. ADHESIVES, STRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
EA 956 A/B	HYS	BS502534	Low viscosity, transparent, amber, semi-rigid epoxy-polyamide adhesive. Cures at room temperature but requires cure at 93°C(200°F) for best properties. Service temperature is from -57 to 93°C(-70 to 200°F). <u>Notes A1 and B1.</u>
EA 9309 A/B	HYS	BS506322	High viscosity, opaque, gray, semi-rigid epoxy. Very high shear strength and peel strength at room temperature. Poor retention of these properties at moderate elevated temperatures. Use per FS509331. Can be cured at any temperature between room temperature and 121°C(250°F). Service temperature is from -57 to 121°C(-70 to 250°F). <u>Note A4.</u>
EA 9394 A/B	HYS	BS515059	A medium viscosity two-part, 100-percent solids, epoxy structural adhesive with filler. Bonds metals, plastics, rubber, and glass. Cure is at 25°C(77°F) or 94°C(200°F) for 1 hour. Possesses excellent peel and tensile shear strength to 177°C(350°F) and short term strength at 260°C(500°F). Also suitable for potting, filling and liquid shim/gap applications. Replaces EA 934 A/B in ZPS-4071-0010. (EA 934 A/B is obsolete). Use EA 9394 A/B as replacement. <u>Note A1.</u>
EA 9396 A/B	HYS	BS515846	Low viscosity room temperature curing semi-rigid unfilled epoxy-polyamide adhesive. Bonds metals, plastics, rubber, and glass where moderately high peel strength is required. Useful where thin bond lines are required, or for potting and filling thin crevices. Accelerated cures at 65°C(150°F) or 82°C(180°F) for one hour may be used. Service temperature is from -57 to 177°C(-70 to 350°F). <u>Note A1.</u>
EA 9446A/B	HYS	BS513532	Two-part, 100-percent solids rapid cure acrylic adhesive system. High shear and peel strength for most substrates. Moderate retention of these properties at elevated temperatures. Full cure is achieved in 24 hours at room temperature. Used where bonding in place of parts to a subsystem is required. Operational temperature range is from -55 to 121°C(-67 to 250°F). <u>Note A4.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-3. ADHESIVES, STRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
EA 9649R	HYS	BS513277	A 100-percent solids, modified epoxy film adhesive. Use for metal-to-metal and honeycomb core sandwich structural bonding. Requires EA 9205 primer. For long-time service at 177°C(350°F), intermittent service at 216°C(420°F). Requires a one-hour cure at 177°C(350°F). <u>Note A1.</u>
Eccobond 104	GWR ECI	BS502568	Ultra high temperature epoxide adhesive. High viscosity, filled, opaque, green epoxy. Use for bonding circuit boards. Requires elevated temperature cure. For optimum performance at temperatures above 204°C(400°F) a post cure at 260°C(500°F) is recommended. <u>Note A1.</u>
EPK IC	HYS	BS515787	A general purpose two-part adhesive/sealant that hardens within 24 hours and fully cures in 7 days. Used to fill plated-through holes in PWBs* and holes electrically isolated from circuitry. Also bonds metals, glass, ceramics, graphite epoxy. Operational temperature is from -46°C to 149°C(-50° to 300°F). See D-8208, Section 3.18. <u>Note A1.</u>
Epon 828	SCA	BS502506 (Epoxy)	Medium viscosity, general purpose, flexibilized epoxy adhesive. Use per FS505153. Type I is high shear strength formulation. Type II has lower shear strength, but increased flexibility and elongation. Class 1 formulations are unfilled, Class 2 formulations contain glass beads for control of bondline thickness. Class 3 formulations are filled with CAB-O-SIL for those applications requiring a nonslumping adhesive. Elevated temperature cures from 65° to 121°C(150° to 250°F) are required for structural bonds. Service temperature is from -57 to 121°C(-70 to 250°F). <u>Note A1.</u>
Epon 871	SCA	BS506317 (Flexibilizer)	
AEP	REV	BS506318 (Curing Agent)	
Colloidal Silica (CAB-O-SIL M-5)	CAB	BS502697 (Filler)	
Glass Beads	MMMd	HMS-20-1776A	
FM 37, FM 40, FM 41	ACYa	BS513305	Modified epoxy adhesives which foam on curing. Use to densify honeycomb core, to close out honeycomb sandwich edges, to splice honeycomb core sections, to provide a shear tie between sandwich components and to bond inserts to honeycomb. FM 37 cures at moderate temperature 107 to 121°C(225 to 250°F). FM 40 cures at high temperature 163 to 177°C(325 to 350°F). FM 41 cures at moderate to high temperature 107 to 177°C(225 to 350°F). Service temperature is from -55 to 177°C(-67 to 350°F). <u>Note A1.</u>

*Printed Wiring Boards

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-3. ADHESIVES, STRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
FM 47, Liquid	ACYa	BS502693	Can be used as structural adhesive or primer. A one-part system consisting of a vinyl-phenolic adhesive in a solvent. Use as a primer for FM 47 adhesive films on metal facing and honeycomb core. Use alone as a metal-to-metal adhesive where a liquid adhesive is preferred. Requires cure for 2 hours at 177°C(350°F) at pressure of 0.10 to 3.45 MPa (15 to 500 psi). Service temperature is from -55 to 177°C(-67 to 350°F). <u>Note A4.</u>
FM 47, Unsupported Film	ACYa	BS502694	An unsupported, vinyl-phenolic film adhesive. Use to splice honeycomb core. Requires cure for 2 hours at 177°C(350°F) at pressure of 1.38 MPa (200 psi). Service temperature is from -55 to 177°C(-67 to 350°F). <u>Note A4.</u>
FM 73 FM 73M	ACYa	BS506337	A 100-percent solids modified epoxy structural adhesive. Use for metal-to-metal and honeycomb sandwich structural bonding. Excellent shear strength to temperatures as high as 121°C(250°F). Can be cured over a wide range of temperatures from 93 to 121°C(200° to 250°F). BR127 primer recommended. Service temperature is from -55 to 121°C(-67 to 250°F). <u>Note A1.</u>
FM 96U	ACYa	BS502532	An unsupported, modified epoxy film adhesive for bonding metals and structural plastic laminates. Excellent shear strength to temperatures as high 177°C(350°F). Requires cure at 177°C(350°F). BR127 primer recommended. Service temperature is from -55 to 177°C(-67 to 350°F). <u>Note A1.</u>
FM 123-2LVC	ACYa	BS502692	A 100-percent solids, modified nitrile epoxy supported film adhesive. Use for metal-to-metal and honeycomb core sandwich structural bonding. Excellent shear strength to temperatures as high as 121°C(250°F). Requires cure at temperatures of 107 to 121°C(225 to 250°F). BR127 primer required. Service temperature is from -57 to 121°C(-70 to 250°F). <u>Note A1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-3. ADHESIVES, STRUCTURAL (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
FM 300-2K	ACYa	MIL-A-25463 MMM-A-132	A high temperature low curing modified epoxy adhesive with support knit film requires cure temperature of 107 to 121°C(225° to 250°F) with pressure. Excellent shear strength at 149°C(300°F). BR127 primer required. Service temperature is from -55 to 150°C(-67 to 300°F). <u>Notes A1 and B3.</u>
HT 424	ACYa	MMM-A-132 MIL-A-25463	An aluminum-filled modified epoxy-phenolic resin coated on a glass carrier. Developed for bonding metal-to-metal, and for sandwich composite structures requiring long-time exposures to 150°C(300°F) and short-time exposures to 260°C(500°F). HT 424 may be used with or without primers HT 424 and HT 424F. <u>Note A2.</u>
HT 432	ACYa	MMM-A-132 MIL-A-25463	A gray, semi-tacky, aluminum-filled epoxy-phenolic glass cloth reinforced film (H5 424 resin on a lighter carrier). Used as a multipurpose, high temperature structural adhesive. Used with or without primer. Primers are HT424 or HT424F. Cure: 170°C(338°F) for 45 minutes under pressure. Use for bonding structural components. Service temperatures up to 204°C(400°F). Short time exposures up to 260°C(500°F). <u>Note A2.</u>
Scotch-Weld 2216 B/A Gray	MMMa	BS502533 MIL-A-25463	Two-part, 100-percent solids, opaque, gray, flexibilized modified epoxy. Use for general purpose bonding. Poor retention of properties at elevated temperatures. Can be cured 7 days at room temperature or 2 hours at 65°C(150°F). Use per FS502752 or D-8208, Section 3.18. Use for electronic component and fastener bonding; also as a general purpose contact bonding and transformer gap cement for electronic packaging. Service temperature is from -57 to 82°C(-70 to 180°F). <u>Note A1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-4. COATING AND PAINT PRIMERS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
AEROGLAZE 9929 A/B	LOR	To be qualified	Replacement for Chemglaze 9922 A/B. A two-part polyamide-cured epoxy primer designed for use on metals under moisture-curing polyurethane base paints. Has good chemical and solvent resistance. Use wherever maximum performance in extreme environments is required and where good adhesion between paint and metal is mandatory. NOTE: Primer remains to be tested and qualified. <u>Notes A1 and B3.</u>
AKZ0 463-6-27	AKZ	MIL-C-22750	Two-component epoxy primer designed to provide good corrosion resistance and adhesion to metallic substrates. 1 part epoxy primer, 1 part catalyst (by volume), and 0-0.15 part TL-52 thinner. Cure at room temperature from 1 to 24 hours. <u>Notes A1 and B3.</u>
CHEMGLAZE 9420 A/B	LOR	— *	A single component moisture-curing urethane primer, aluminum pigmented. Aluminum tint gives contrast upon application. Good for steel surfaces. Drying time: 3 hours at room temperature. <u>Notes A1 and B3.</u>
CHEMGLAZE 9924 A/B	LOR	LORD BULLETIN DS10-7524	A two-part wash primer, consisting of a modified polyvinyl butyral resin and a phosphoric acid catalyst. Good for priming non-ferrous substrates such as aluminum and galvanized steel. Use in conjunction with Chemglaze or Aeroglaze polyurethane coatings. Dries quickly between 18 to 24°C(65 to 75°F). <u>Notes A2 and B3.</u>
CHEMGLAZE 9965	LOR	MIL-P-24441	Epoxy metal primer, A/B; part B is a polyamide resin. To be used with Chemglaze PU coatings. Primer for steel and aluminum substrates. Drying time: 3 hours at room temperature, with full cure in 7 days. <u>Notes A1 and B3.</u>
CHEMLOK AP 134	LOR	— *	A one-component silane-based adhesive primer; an excellent substrate primer for epoxy, urethane, phenolic and vinyl systems. Diluents consist of toluene, ethanol and methanol. Also compatible with numerous sealants, coatings, rubbers and resins. Air drying at room temperature in 15 to 40 minutes. <u>Notes A1 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-4. COATING AND PAINT PRIMERS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Solithane* 113-No. 1	UNC	SAE/AMS 3137	A clear, pale yellow urethane polymer. Can be used as protective coating for metallic and nonmetallic surfaces. Spray, dip, or brush application. Meets spacecraft material outgassing requirements of JSC SP-R-0022A. <u>Notes A1 and B3.</u>
Solithane* 113-No. 4	UNC	SAE/AMS 3137	A clear, pale yellow urethane polymer. Can be used as protective coating for metallic and nonmetallic surfaces. Spray, dip, or brush application. Meets spacecraft material outgassing requirements of JSC SP-R-0022A. <u>Notes A1 and B3.</u>

*For applications below -5°C(23°F) see Materials or Packaging Engineers.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-5. COMPOSITES AND LAMINATES

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
RT/duroid 6010	ROG ₍₂₎	IPC-TM-650*	A ceramic-filled teflon (PTFE) microwave laminate used in PWBs. Formulation is proprietary. Operating temperature: -100° to 250°C(-148 to 482°F). Tg** = -113°C(-171°F) and 127°C(261°F). Laminates supplied clad both sides with 0.38 to 6.1 gm/cm ² (1/8 to 2 oz/ft ²) electrodeposited (ED) copper foil. <u>Notes A1 and B1.</u>
Epoxy Glass Laminate, Natural Color	DCE	MIL-P-25421	Tubing, Type 1, Class 2, used for transformer and inductor potting cups. For non-structural use only (ST11086). (FS500443). Also refer to (ST 10603 to 10606 inclusive) and D-8208, Section 3.13. <u>Notes A1 and B3.</u>
Epoxy Glass Laminate, (Cu Clad), Type GBN	see comments	MIL-P-13949/2	Sheet, natural color, heat resistant grade; buy per QPL-13949. <u>Notes A1 and B3.</u>
Epoxy Glass Laminate, (Unclad) Type GEN	see comments	MIL-P-13949/11	Plastic sheet, laminated (unclad), for PWB, glass base, woven, epoxy resin preimpregnated. Buy per QPL-13949. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Cu Clad), Type GEB	see comments	MIL-I-24768/28	Heat resistant sheet, natural color, specify flame retardant, NEMA Grade FR-5; buy per QPL-18177. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Cu Clad), Type GEE	see comments	MIL-I-24768/28	Sheet, natural color, general purpose, standard grade; buy per QPL-18177. <u>Notes A1 and B3.</u>
Epoxy Glass Laminate, Type GEE-F	see comments	MIL-I-24768/27	Sheet, natural color, specify flame retardant; buy per QPL-18177. General purpose type. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Cu Clad), Type GEN	see comments	MIL-P-13949/3	Sheet, natural color, general purpose, standard grade; buy per QPL-13949. <u>Notes A1 and B3.</u>

*IPC = Institute for Interconnecting and Packaging Electronic Circuits

**Tg = Amorphous glass transitions for PTFE

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-5. COMPOSITES AND LAMINATES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Epoxy Glass Laminate, Cu Clad, Type GF	see comments	MIL-P-13949/4	Plastic sheet, laminated, Cu-Clad for PWB, glass base, epoxy resin, flame retardant. Buy per QPL-13949. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Cu Clad), Type GFN	see comments	MIL-P-13949/4	Sheet, natural color, etched, uses Cu both sides, flame retardant grade; buy per QPL-13949. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Cu Clad), Type GHN	see comments	MIL-P-13949/5	Sheet, natural color, heat resistant, flame retardant grade; buy per QPL-13949. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, Cu Clad, Type GI	see comments	MIL-P-13949/10	Plastic sheet, laminated, Cu-Clad for PWB, glass base, woven, polyimide resin, heat resistant. Buy per QPL-13949. <u>Notes A1 and B2.</u>
Epoxy Glass Laminate, (Unclad) NEMA-G10	see comments	MIL-I-24768/2	A continuous filament glass cloth/epoxy resin binder, unclad. Used as a printed circuit board substrate. Properties: Refer to Insulation/Circuits Desk Manual, Vol. 28, No. 7, 6/7 1982. <u>Notes A1 and B3.</u>
Graphite Filament, Preimpregnated, Epoxy Resin	SPS FIB HCL BAS BPC	BS506308	Graphite-epoxy, unidirectional tape for filament winding and other high strength requirements. Available in thicknesses of 0.064 and 0.127 mm (0.0025 and 0.005 inch). Graphite fibers with moduli ranging from 241,500 MPa (35 MSI) to greater than 517,500 MPa (75 MSI) are included. <u>Notes A1 and B3.</u>
EPR 121RA APR 121RA	WEL (formerly Fortin)	IPC-FC-241/2* IPC-FC-241/1	Basic laminate for flex printed wire. 0.05 mm (0.002 inch) Kapton with 102 RA copper clad both sides. Copper bonded to Kapton with 0.025 mm (0.001 inch) epoxy adhesive. APR designates using acrylic adhesive. <u>Notes A1 and B4.</u>

*IPC = Institute for Interconnecting and Packaging Electronic Circuits.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-5. COMPOSITES AND LAMINATES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Glass-reinforced dielectrics and prepreg. (Epoxy or Polyimide)	see comments	MIL-P-13949/12 MIL-P-13949/13	Glass reinforced materials used for the bonding of rigidized stiffeners; shall be of type GF or GI as specified in MIL-P-13949. Buy per QPL-13949. <u>Notes A1 and B3 (Epoxy) Notes A1 and B2 (Polyimide).</u>
Graphite Fabric Preimpregnated, Epoxy Resin	SPS FIB HCL HIT BAS	BS506340	Epoxy/Graphite fabric prepreg; lightweight, high modulus structures. Nominal cured thickness, 0.0127 mm (0.005 inch) per ply. Graphite fibers with moduli ranging from 241,500 MPa (35 MSI) to over 517,500 MPa (75 MSI) are included. <u>Notes A1 and B3.</u>
Graphite Filament Preimpregnated, Polyimide Resin	BCP STS	BS513087	Graphite-polyimide unidirectional preimpregnated tape. Use in the fabrication of laminated, structural, reinforced plastic parts with high temperature resistance. <u>Notes A1 and B2.</u>
Micarta 20201-2	WEC	BS502500	Silicone-glass cloth laminate. <u>Notes A1 and B2.</u>
Micarta H-2497	WEC	BS502502 MIL-I-24768/3	Epoxy/fiberglass fabric laminate, NEMA Grade G-11; buy per QPL-18177, Type GEB. Retains good mechanical strength up to 150°C(302°F). Retains 50% of its flexural strength at elevated temperatures. <u>Notes A1 and B3.</u>
Micarta H17825	WEC	BS502500	Silicone/fiberglass fabric; type GSG; tubing grade is Micarta HY1806. <u>Notes A1 and B2.</u>
Micarta HY-180 HY-180-1	WEC	BS502510 LP 509-IV (HY-180 only)	Epoxy/fiberglass fabric tubing, NEMA Grades G-10 and G-11. Retains good mechanical strength up to 150°C(302°F). G-10 not recommended for mechanical loads at elevated temperatures. <u>Notes A1 and B3.</u>
MXB 7703/Fiberglass	ICI FIB	BS504233 MIL-R-9300	Epoxy/fiberglass prepreg; used for solar panel dielectric. <u>Notes A1 and B3.</u>
Polyimide Glass Laminate, (Unclad) Type GI	see comments	MIL-P-13949/13	Plastic sheet, laminated (unclad), for PWB, glass base, woven, polyimide resin, preimpregnated ("B"-stage). Buy per QPL-13949. <u>Notes A1 and B2.</u>
Prepreg Glass Cloth, Type GF	see comments	MIL-P-13949/12	"B" stage, sheet, for multilayer boards; specify flame retardant; buy per QPL-13949. <u>Notes A6 and B2.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-5. COMPOSITES AND LAMINATES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Prepreg Tape 5505/4 Boron Epoxy	TEX	BS504227	Unidirectional boron filament-reinforced epoxy resin prepreg tape; used for filament winding and other high strength composite requirements. <u>Notes A1 and B3.</u>
Pyrallux LF 0100	DUP _c	MIL-P-46112 IPC-FC-241/1*	Backers and covers for flexible printed wire. Adhesive backed with modified phenolic butyral semi-cured "B" stage 0.025 mm (0.001 inch) acrylic adhesive sheet. - purchase through Circuit Image Systems, Orange, CA 92668 <u>Notes A6 and B4.</u>
Pyrallux LF 9120 RA	DUP _c	MIL-P-46112 IPC-FC-241/1	Basic laminate for flexible printed wire, 28.35 gm (1 oz) copper, 0.050 mm (0.002 inch) Kapton (polyimide) plus 0.025 mm (0.001 inch) adhesive Pyrallux LF 0100. Purchase through Circuit Image Systems, Orange, CA 92668 <u>Notes A6 and B4.</u>
RT/duroid 6010	ROG ₍₂₎	IPC-TM-650*	A ceramic-filled teflon (PTFE) microwave laminate used in PWBs. Formulation is proprietary. Operating temperature: -100° to 250°C (-148 to 482°F). Tg** = -113°C (-171°F) and 127°C (261°F). Laminates supplied clad both sides with 0.38 to 6.1 gm/cm ² (1/8 to 2 oz/ft ²) electrodeposited (ED) copper foil. <u>Notes A1 and B1.</u>
Scotchply SP-250-S29 (supersedes SP-250-S2)	MMM _d	BS502531 MIL-R-9300	Unidirectional fiberglass epoxy preimpregnated tape. Operating temperature: -54°C to 121°C (-65 to 250°F). Utilizes Owens Corning S2-449 glass. Type, class and cloth base shall be specified. <u>Notes A1 and B2.</u>
Scotchply UNI Type 1002	MMM _d	MIL-P-18177 MIL-P-25421 MIL-R-9300	Unidirectional fiberglass epoxy preimpregnated thermosetting structural grade. Operating temperature: -54°C to 130°C (-65 to 266°F). Type, class and cloth base shall be specified. <u>Notes A1 and B2.</u>

*IPC = Institute for Interconnecting and Packaging Electronic Circuits.

**Tg = Amorphous glass transitions for PTFE

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-6. CONFORMAL COATINGS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
CI-6/BA-45	BII	MIL-C-82644 TYPE III	A two-part unfilled, low viscosity epoxy resin system. Used for impregnation of electronic components containing a high percentage of wires where complete penetration and freedom of voids is required. See D-8208, Section 3.18. Tg* = 109°C(228°F) for 100°C(212°F) cure. <u>Notes A1 and B3.</u>
Conathane CE 1155	CON	MIL-I-46058	A two component, solvent-based polyurethane coating system for extremely adverse environments. High resistance to moisture and abrasion. Easy to repair. Cures at room temperature and elevated temperature of 65°C(150°F). Tg = -59°C(-74°F). <u>Notes A1 and B3.</u>
RTV 60	GEC _b	BS502511	A two-part, red silicone rubber, medium viscosity uncured; used for conformal encapsulation of electrical conductors exposed to ultraviolet light. See D-8208, Section 3.18. <u>Notes A4 and B2.</u>
Solithane** 113/C113-300	UNC	BS502695 (Resin and Catalyst)	Semiflexible, transparent, polyurethane resin with fluorescent trace, used for conformal encapsulation of electrical conductors; for nonlight sensitive equipment. Glass transition temperature (Tg) varies with degree of cure. Not recommended for high voltage applications (> 200 volts). See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Calcofluor White, RWP Conc.	ACY _b	BS502696 (Indicator)	
Colloidal Silica (CAB-O-SIL M-5)	CAB	BS502697 (Filler)	
T-12	GEC _b	BS502698 (Accelerator)	
Solithane** 113/C113-300	UNC	BS502695 (Resin and Catalyst)	Flexible, transparent, polyurethane resin with fluorescent trace, for coating of light-sensitive equipment. Available in premixed, frozen kits. Glass transition temperature (Tg) varies with cure temperature. Not recommended for high voltage applications (> 200 volts). See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Calcofluor White, RWP Conc.	ACY _b	BS502696 (Indicator)	
T-12	GEC _b	BS502698 (Accelerator)	

*Glass transition temperature.

**For applications below -5°C (23°F) see Materials or Packaging Engineers

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-6. CONFORMAL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Solithane* 113/C113-300	UNC	BS502695 (Resin and Catalyst)	Nonfluorescent, semiflexible, transparent, polyurethane resin; used for conformal encapsulation of electrical conductors such as terminals and electronic part leads, for light-sensitive equipment. Glass transition temperature (T _g) varies with degree of cure. Not recommended for high voltage applications (>200 volts). See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Colloidal Silica (CAB-O-SIL M-5)	CAB	BS502697 (Filler)	
T-12	GEC ₆	BS502698 (Accelerator)	
Solithane* 113/C113-300	UNC	BS502695 (Resin and Catalyst)	Nonfluorescent, semiflexible, transparent, polyurethane resin; used for coating of electronic parts, mounting surfaces and temperature transducer bonding. Available in premixed, frozen kit. May be used for bonding screws by brush coating threads. Glass transition temperature (T _g) varies with degree of cure. Not recommended for high voltage applications (>200 volts). See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
T-12	GEC ₆	BS502698 (Accelerator)	
Uralane 5750-A/B (LV)	FAP	BS515376 MIL-I-46058	A two-component pourable liquid urethane conformal coating, designed specifically for printed circuit boards and electronic components. Excellent resistance to heat and high humidity conditions. Cured coating has low outgassing properties, is translucent, soft and repairable. Glass transition temperature (T _g) is -67°C(-89°F). See D-8208, Section 3.18. Use per FS515377. <u>Notes A1 and B3.</u>

*For applications below -5°C (23°F) see Materials or Packaging Engineers

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-7. ELASTOMERS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
CHO-SEAL 1221	CHO	— *	A tan, opaque, silver-filled, fluorosilicone flexible rubber, aerospace 200 grade. A homogeneous, electrically conductive, composite rubber used for EMI/RFI shielding. Shore A durometer hardness: 73; continuous use temperature, 200°C(392°F). Maximum DC voltage resistivity 4×10^{-3} ohm/cm. Available in sheet form. <u>Notes A1 and B3.</u>
Hadbar 2880	HBR	BS502675 ZZ-R-765, Grade 80	Silicone rubber; sheet, strip, tubing, molded shapes, extrusions. Procure to specification. <u>Notes A2 and B2.</u>
JPL No. 10 (Viton)	DUP _a	BS502523	A fluoroelastomer used for spacers and gaskets. See specification for formulation and processing. <u>Notes A6 and B2.</u>
L-677-70 (Supersedes L449-6 and L608-6)	PSC _a	BS502678 MIL-R-25988, Type I, Class I, Grade 70	A fluorosilicone used for seals, spacers and gaskets. Procure to specification. <u>Notes A1 and B2.</u>
Parker V709-90 (V399-9) V1905-90 (Viton)	PHC _a	BS504187 MIL-R-83248	A fluoroelastomer used for O-ring backup, O-rings, molded shapes, sheet, strip, and extruded shapes. Procure to specification. <u>Notes A6 and B2.</u>
Parker V747-75 (Viton)	PHC _b	BS504186 MIL-R-83248, Type I, Class 2	Viton fluoroelastomer; rubber, high temperature, fluid resistant. Produces rubber-to-metal seal products, molded shapes, sheet, strip, and extruded shapes. Shore A Durometer hardness: 70. Continuous service temperature: 204°C(400°F). Brittle point: -45°C(-49°F). Procure to specification. <u>Notes A1 and B2.</u>
SE-3604U/Varox	GEC _b	BS502538 ZZ-R-765, Class 2b, Grade 60	A silicone rubber compound used for seals, spacers, and gaskets (ST10026). Procure to specification. <u>Notes A1 and B2.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-8. EPOXY RESINS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Epon 828	SCA	BS502506	Amber color, general purpose epoxy resin (covers resin only).
Epon 828 Catalyst A	REV	BS502620	Amber color, general purpose epoxy laminating resin with curing agent "A" for moderate temperature cure and use. <u>Notes A1 and B3.</u>
Epon 828/U	SCA	BS502606	Amber color, general purpose epoxy laminating resin with curing agent "U" for room temperature cure and use. <u>Notes A1 and B3.</u>
Epon 828/Z	SCA	BS502621	Amber color, general purpose epoxy casting resin with curing agent "Z" for elevated temperature use; requires high temperature cure. <u>Notes A1 and B3.</u>
Epon 871	SCA	BS506317	An aliphatic polyepoxide resin used to promote flexibility. Used in combination with other resins, adhesives and laminates. <u>Notes A1 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-9. FABRICS AND THIN LAMINATES

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Fabric, Glass (except Style 108)	OWC SJP	MIL-C-9084	Fiberglass, various styles. Does not include Style 108 fabric. (Specify finish, type, style and class). <u>Notes A1 and B1.</u>
Fabric, Glass Style 108	OWC SJP	MIL-Y-1140	Fiberglass, dielectric face sheet cloth. (Specify finish required). <u>Notes A1 and B1.</u>
Fabric, Glass 112 or 2112	SHD	MIL-C-9084	Fabric used in lamination construction, for example with Kapton XC. <u>Notes A1 and B1.</u>
Fabric, Nomex	DUP _a	Sheldahl P/N F015510	Nomex fabric produced from aramid fibers with good dimensional stability and excellent heat resistance. Does not melt; this fiber will degrade rapidly at temperatures above 371°C(700°F). Weight of fabric to be specified in gm/m ² (oz/yd ²). Weave is 6.3 x 5.9 count per cm (16 x 15 count per inch). <u>Notes A1 and B3.</u>
Fabric, Polyester (Dacron)	SJP	BS505773	Plain weave 44 x 31 yarns/cm (113 x 80 yarns/inch), 70 denier: 66 gm/m ² (1.95 oz/yd ²), or other weave count must be specified. <u>Notes A1 and B3.</u>
Fluorglas 389-7 (Beta Cloth)	FLG	BS506328 MBO 135-027 (Rockwell)	Fluorocarbon, PTFE ⁽¹⁾ Teflon coated betaglass fabric 0.020 ±0.003 mm (0.008 ±0.001 inch) thickness. Material is used in the construction of thermal blankets. Meets NASA requirements. Also known as betacloth. Material callout shall state form(s) required for procurement. <u>Notes A1 and B1.</u>
Laminate, Kapton XC Nomex Fabric 3P Adhesive	SHD DUP _a	P/N 6181401	Used for thermal blanket outer layer construction or sun shields where high α_s and ϵ_n ⁽²⁾ are required. Maximum service temperature is 260°C(500°F). The electrical surface resistivity of Kapton XC shall be specified for a specific requirement. Available resistivity of Kapton XC is from 0.1 k Ω to 10 ¹⁵ Ω . <u>Notes A1 and B3.</u>
Laminate, Kapton XC Glass Fabric, 112 or 2112 3P Adhesive	SHD DUP _a	P/N 6181400	Used for thermal blanket outer layer construction or sun shields where high α_s and ϵ_n are required. Maximum service temperature is 260°C(500°F). Specify electrical resistivity. <u>Notes A1 and B3.</u>

⁽¹⁾Polytetrafluoroethylene⁽²⁾ α_s solar absorptance; ϵ_n normal emittance

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-10. FILMS AND SHEETS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
TB 5 PTFE	MMM _f	BS502583	Fiberglass, TFE teflon coated, used for insulation wrap. <u>Notes A1 and B1.</u>
Cronar, Ortho S-Litho	DUP _a	BS502685	Polyester photographic film; used for welded module spacers and fabrication aids (ST10065). <u>Notes A6 and B3.</u>
Dacron Mesh B2A	APM	— *	Mesh used for thermal blankets to separate other film layers. Melting point: 249°C(480°F). <u>Notes A1 and B3.</u>
Fluorocarbon (Teflon), FEP ⁽¹⁾	DUP _a	ASTM D3368	Fluorocarbon film, sheet, sleeving; translucent to white (ST10025). <u>Notes A1 and B1.</u>
Fluorocarbon (Teflon), FEP Aluminized	DUP _a	BS502543	Aluminized fluorocarbon film; used in construction of thermal blankets. <u>Notes A1 and B1.</u>
Fluorocarbon ⁽²⁾ (Teflon), TFE	DUP _a	MIL-P-22241	Fluorocarbon molded or skived sheet used for insulation sheet (ST10067). <u>Notes A1 and B1.</u>
Kapton, Type F	DUP _a	BS502670	Polyimide/FEP fluorocarbon film. Combination of Kapton Type H coated on one or two sides with Teflon FEP resin. Provides a heat-sealable surface on a non-melting polyimide base. Film thickness varies from 0.038 to 0.15 mm (0.0015 to 0.006 inch). <u>Notes A1 and B2.</u>
Kapton, Type H	DUP _a	BS502578	Polyimide film. Service temperatures from -269° to 400°C(-452° to 752°F). Film thickness varies from 0.012 to 0.13 mm (0.0005 to 0.005 inch). <u>Notes A1 and B2.</u>

⁽¹⁾FEP - Fluorinated ethylene propylene⁽²⁾TFE - Tetrafluoroethylene⁽³⁾VDA - Vacuum deposited aluminum

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-10. FILMS AND SHEETS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Kapton, Type H Aluminized	KST SHD DUP _a	BS506333	Aluminized polyimide film. <u>Notes A1 and B2.</u>
Kapton VDA ⁽³⁾ Embossed and Perforated	DNC MPI NMX SHD	— *	VDA 99.9% pure mirror-like aluminum film. Perforated to a 1% open area, perforating specialties No. 9803 or equivalent, embossed with 20.3 x 20.3/sq. cm (8x8/sq in.) tile pattern, flexcon MHV-600-FS or equivalent. Resistivity shall not exceed 20 ohms/sq. in. Maximum service temperature is 260°C(500°F). <u>Notes A1 and B1.</u>
Kapton XC (Carbon Filled)	DUP _d	— *	Carbon filled Kapton (polyimide) film. Thickness and level of electrical conductivity shall be specified. Thickness varies from 0.025 to 0.13 mm (0.001 to 0.005 in.). Maximum service temperature is 260°C(500°F). <u>Notes A1 and B1.</u>

⁽¹⁾FEP - Fluorinated ethylene propylene⁽²⁾TFE - Tetrafluoroethylene⁽³⁾VDA - Vacuum deposited aluminum

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-10. FILMS AND SHEETS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Mylar, Type A	DUP _a	BS502504	Polyethylene terephthalate film; used for insulation sheet and backing for tapes. Service temperature from -70°C to 150°C(-94° to 302°F). Contains no plasticizers and does not become brittle with age under normal conditions. Melting point: 250°C(482°F). <u>Notes A1 and B3.</u>
Mylar, Type A, Aluminized	DUP _a	BS502505	Aluminized polyethylene terephthalate film; used for inner layers of thermal blankets. <u>Notes A1 and B3.</u>
Tedlar, Type 30 Modification B High Gloss	DUP _a	BS502550	Polyvinyl fluoride film used for insulation. Film has a high dielectric strength. Continuous use temperature: -72 to 107°C(-98 to 225°F). <u>Notes A1 and B3.</u>
Tedlar, Type 30 Modification B High Gloss, Aluminized	DUP _a	BS502551	Aluminized polyvinyl fluoride film; used for insulation. Type, class, style and base shall be specified. Film has a high dielectric strength. <u>Notes A1 and B3.</u>
Tefzel 200	DUP _d	SAE/AMS 3532	A copolymer film that is composed of ethylene and tetrafluoroethylene. This film is suited for electrical insulation and injected molded parts. Melting point, DTA* peak, 270°C(518°F); service temperature (extended periods) 150°C(302°F). <u>Notes A1 and B1.</u>

*DTA - Differential Thermal Analysis

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-11. GLASSES AND CERAMICS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
AD-995 Aluminum Oxide	CPC	— *	A white polycrystalline aluminum oxide. Used for electrical flat packs and as an electrical substrate. Density is 3.90 g/cm ³ . Note: This material is susceptible to subcritical crack growth in a moist environment when stress loaded. CTE** = K ⁻¹ 6.0 x 10 ⁻⁶ (°F ⁻¹ ~3.3 x 10 ⁻⁶). Notes A1 and B1.
Beryllium Oxide BeO	CPC BWC	ASTM C708	A polycrystalline, sintered beryllium oxide. Used as an electrically insulating heat sink. Density is 2.85 g/cm ³ ; CTE = K ⁻¹ 5.7 x 10 ⁻⁶ (°F ⁻¹ ~3.2 x 10 ⁻⁶). <u>WARNING: This material is very toxic in powdered or metallic form.</u> Notes A1 and B1.
Code 7570 Borosilicate	COR	— *	A low melting, high lead, borosilicate nonrecrystallizing solder glass. This material is used for electrical flat pack hermetic seals. CTE = K ⁻¹ 8.4 x 10 ⁻⁶ (°F ⁻¹ ~4.7 x 10 ⁻⁶). Notes A1 and B1
Code 7940	COR	Corning Glass M-975	Synthetic fused silica (SiO ₂). Material is transparent glass commonly used for solar cell coverslips, and is frequently used for optical elements and windows. Density is 2.20 g/cm ³ ; material is susceptible to subcritical crack growth in a moist environment when loaded in tension. Transmission stability in the presence of UV radiation depends on the amount of impurities in the glass. CTE = 5 x 10 ⁻⁷ cm/cm/°C (°F ⁻¹ ~2.8 x 10 ⁻⁷) or ~1 ppm. Notes A1 and B1
Code 7971	COR	Corning Glass M-976	Ultra low expansion (ULE) titania doped fused silica - contains 7% titania (TiO ₂). CTE = 1.0 x 10 ⁻⁹ cm/cm/°F (°F ⁻¹ ~0.05 x 10 ⁻⁹) or ~1 ppb. Notes A1 and B1
MACOR Code 9658	COR	AMS 3880 MIL-I-10	A white machinable glass-ceramic with a fluorophlogopite mica composition. Density, 2.52 g/cm ³ . Used for spark chamber frames for unconventional electrical and vacuum feedthroughs that require machining. This material is susceptible to subcritical crack growth in a moist environment when loaded in tension. Strength and machinability vary with material's thermal history. CTE = K ⁻¹ 9.4 x 10 ⁻⁶ (°F ⁻¹ ~5.2 x 10 ⁻⁶). Notes A1 and B1.

*Specification could not be found.

**Coefficient of Thermal Expansion

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS**Table 3.2-11. GLASSES AND CERAMICS (Cont'd)**

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Suprasil 1	HER	Heraeus Amersil Specifications Bulletin 40-1015-079 A and E3C 10.90/NT & D	Quartz glass, silicon dioxide (SiO ₂). High UV and IR transmittance for optics. Used for high intensity laser and flashlamp applications; forms, ingots, plates, rods, and prisms. Grades and shapes shall be specified. <u>Notes A1 and B1.</u>
Suprasil W	HER	Heraeus Amersil Specifications Bulletin 40-1015-079 A and E3C 10.90/NT & D	Quartz glass, silicon dioxide (SiO ₂). Used for optics applications, laser windows, mirrors and lenses, spectrophotometer windows and cells, fiber optics, prisms, and Schlieren and Brewster angle windows. Grades and shapes shall be specified. <u>Notes A1 and B1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-12. LUBRICANTS AND GREASES

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Apiezon L	BID	BS502618	Petroleum base grease; used as low temperature vacuum grease. Melts at 47°C(117°F). Do not use at temperatures above 30°C(86°F). <u>Notes A1 and B3.</u>
Apiezon L/ MolyKote Z	BID/ HES	BS502561	Thread and fitting grease, 75% Apiezon L petroleum base grease and 25% MolyKote Z Powder (MoS ₂). Molykote Z temperature range from -226° to 400°C(-375° to 750°F). <u>Notes A1 and B3.</u>
Braycote 600	CAS	BS513525	Perfluoropolyalkylether-based, off-white stable grease. Contains tetrafluoroethylene telomer* as a gelling agent. Temperature range from -80 to 200°C(-112° to 392°F). Note: A barrier film must be used with the grease to reduce creep of base oil out of the grease. <u>Notes A1 and B1.</u>
Braycote 601	CAS	BS513526	Perfluoropolyalkylether-based, off-white, stable grease. Contains tetrafluoroethylene telomer as a gelling agent. Contains a rust and corrosion inhibitor. Temperature range from -80 to 204°C(-112° to 400°F). NOTE: A barrier film must be used with the grease to reduce creep of base oil out of the grease. <u>Notes A1 and B1.</u>
Braycote 602	CAS	— **	A stable grease made with a perfluorinated polyether base oil thickened with TFE (tetrafluoroethylene) with molybdenum disulfide added. Use in place of Braycote 601 when heavier loads are encountered. A barrier film must be used with the grease to reduce creep of the base oil out of the grease. Temperature range from -80 to 204°C(-112 to 400°F). <u>Notes A1 and B1.</u>

*A polymer with a low degree of polymerization (from 50 to 200 molecular units).

**Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-12. LUBRICANTS AND GREASES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Brayco Micronic 815Z	CAS	BS513169	Perfluoropolyalkylether, clear, colorless, liquid lubricant. Suitable for use in high vacuum over a wide range of temperatures from -49° to 260°C(-120° to 500°F). A barrier film must be used to reduce creep of the Brayco 815Z out of working area of the component. Used in space for the lubrication of ball bearings, lightly loaded gears and sliding components. <u>Notes A1 and B1.</u>
Dicronite	DDL	DOD-L-85645	A modified lamellar composition of tungsten disulfide, a dry film lubricant. Compatible with all oils, greases and release agents; used for dissimilar metals and dissimilar hardness; withstands high loads. Operating temperature range between -188° and 588°C(-350 and 1000°F). Low outgassing characteristics. <u>Note A6.</u>
Laminar X-500 Teflon White 8-W-24 (Formerly Magna Coating)	DCM	BS504192	Filled fluorocarbon lubricant coating (Teflon). <u>Notes A6 and B1.</u>
Lub-Lok No. 2396	EMC	BS502557	Sodium silicate/MoS ₂ ; solid film lubricant, dull gray-black in color. <u>Notes A4 and B1.</u>
Lub-Lok No. 4306	EMC	BS502546	Phenolic/MoS ₂ ; solid film lubricant, dull gray-black in color. <u>Notes A1 and B4.</u>
Lub-Lok No. 5306	EMC	MIL-L-46010 Type 1	Phenolic/MoS ₂ ; solid film lubricant, dull gray-black in color. Cures at 150°C(300°F) for 1 hour. <u>Notes A1 and B4.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-12. LUBRICANTS AND GREASES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
MolyKote Z Powder	HES	BS502619 MIL-M-7866	MoS ₂ powder, gray-black in color. Use in combination with Apiezon L. <u>Notes A1 and B1.</u>
Rulon AR (Replaces Rulon A) Rulon LD	DIC	BS504205	A specially compounded fluorocarbon. A self-lubricating material used for vacuum situations for ball bearing retainers, idler gears, bushings, and sliding components. Operating temperature range: -240 to 290°C(-400 to 550°F). Good corrosion resistance and low coefficient of friction. <u>Notes A1 and B1.</u>
Rulon 123	DIC	— *	Composition: ~80% teflon based PTFE. Filler is proprietary; a carbon/graphite type, and is nonabrasive. Shore hardness durometer D is 45. Operating temperature range: -240 to 290°C(-400 to 550°F). <u>Notes A1 and B1.</u>
Rulon J	DIC	— *	Composition: ~80% teflon, filler is proprietary. Shore hardness durometer D is 60. Operating temperature range: -240 to 290°C(-400 to 550°F). <u>Notes A1 and B1.</u>
Sputtered MoS ₂ + Ni	HPM	— *	A vacuum deposition where MoS ₂ and 3% nickel are co-sputtered onto a metallic surface for lubrication. Used to lubricate ball bearings that operate at extremely low temperatures to -270°C(-454°F). A thin film with low load-carrying capability. Used where liquid or grease cannot be used. Service temperature range: -220 to 370°C(-365 to 700°F). <u>Notes A1 and B1.</u>
Versilube G-300	GEC _b	BS502654	Silicone lubricating grease. Temperature range: -73 to 260°C(-100 to 500°F). Oxidation resistant and low moisture resistance; not recommended for radiation exposure up to 10 ⁶ Rads. <u>Notes A4 and B2.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-13. MARKING INKS AND LABELS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Inks</u> CAT-L-INK 50-000 Series	DEM	BS502674 MIL-I-43553	A permanent, two-component, epoxy-based screen printing ink. May choose a selection of catalysts which cure at elevated or room temperature. Good adhesion to glass, plastics, ceramics and metals. Used on electronic components, circuit boards, etc. Comes in 28 different colors. Meets outgassing requirements except 50-710, 50-800 and 50-810. Cure varies with catalyst from room temperature to 200°C(392°F). See D-8208, Section 3.6. Can be made to meet requirements of Note A1 by overcoating with an approved epoxy coating. <u>Note A4.</u>
Wornow Ink M-Series (Hysol)	DEM	BS502673 MIL-I-43553	A permanent, two-component, epoxy-based marking ink. May choose a selection of catalysts which cure at elevated or room temperature. Excellent adhesion to glass, metals and plastics. Used for electronics, semiconductor components, PWB's, connectors, nameplates. Cure varies with catalyst from room temperature to 200°C(392°F). See D-8208, Section 3.6. Comes in 9 different colors. Operating temperature range: depends on catalysts used but can go to maximum of 205°C(400°F). Can be made to meet requirements of Note A1 by overcoating with an approved epoxy coating. <u>Note A4.</u>
<u>Inks-Polyurethane</u> Chemglaze Z004 and 5% Chromic Oxide Pigment	LOR FSC	— *	Chemglaze Z004 polyurethane with 5% chromic oxide pigment added. Technical grade powder gives a dark green color; purer grade powder results in a light green color. Cure is for 2 hours at 25°C(77°F) plus 18 hours at 60°C(140°F) or at room temperature from 7 to 10 days. Maximum temperature use: 150°C(300°F). <u>Notes A2 and B3.</u>
<u>Labels</u> Dynamark 8030	MMM ₁	— *	A composite labeling system with a photosensitive surface film on a 0.30 mm (0.012 inch) aluminum substrate with an acrylic adhesive backing. Used as a versatile label or decal for general spacecraft use; e.g., this was used on the space telescope to indicate center of gravity locations. Outgassing test performed with gloss acrylic aerosol spray protective coating 3M 3900 applied over 8030 label meets Note A1 requirements. Maximum service temperature: 120°C(250°F). <u>Notes A1 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-13. MARKING INKS AND LABELS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Labels (cont'd)</u> ScotchCal 8001 (Red)	MMM ₁	— *	This label used for identifying items. The adhesive of the metal label is degraded by some solvents including xylol and heptane, but not ethanol. The label has a pressure-sensitive adhesive on aluminum foil. Useable temperature range: -54 to 93°C(-65 to 200°F). The aluminum foil has a light-sensitive negative acting coating. <u>Notes A1 and B3.</u>
ScotchCal 8005 (Black)	MMM ₁	L-L-0040	This label is used for identifying items. The adhesive of the metal label is degraded by some solvents including xylol and heptane, but not ethanol. The aluminum foil has a light-sensitive negative acting coating and a pressure-sensitive adhesive. Useable temperature range: -54 to 93°C(-65 to 200°F). <u>Notes A1 and B3.</u>
Tuff-Code Mark II	STR	MIL-M-87958	A high-temperature, chemically resistant, off-white mylar label with black numbers. Used mainly as a wire marker and for identifying other items. Solvent resistance: good for water, alcohols and petroleum based solvents. Note: The printing on the labels is covered by a layer of 0.013 mm (0.0005 inch) mylar. Service temperature range: -40 to 177°C(-40 to 350°F). <u>Notes A1 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-14. MOLDED PARTS AND MOLDING COMPOUNDS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Delrin* 100 NC-10	DUP.	BS502503	Acetal resin compound. Greater fatigue life, toughness and elongation than Delrin 500 for highly stressed parts. Extruded or molded (E-M); natural color (NC-10). Service temperature range: -50 to 121°C(-60 to 250°F). <u>Notes A1 and B3.</u>
Delrin 500	DUP.	BS505775	Acetal resin compound. Extruded or molded (E-M). A general purpose resin. <u>Notes A1 and B3.</u>
Delrin 500 AF	DUP.	BS504224	Acetal resin/Teflon fiber filled, low friction, longer wear resistance. <u>Notes A1 and B3.</u>
Delrin 507	DUP.	— **	Acetal resin compound. Similar to Delrin 500, with UV stabilizer and lubricated surface. Tensile strength (unnotched) and Izod impact is much lower than Delrin 500. <u>Notes A1 and B3.</u>
Diall 52-40-40	ROG	BS502518 MIL-M-14/6 Type GDI-30	Diallyl phthalate, long glass/flake. <u>Notes A1 and B3.</u>
Epiall 1914	ROG	BS502642	Epoxy/short glass granular molding compound. Used for terminal blocks, connectors, and circuit holders. <u>Notes A1 and B3.</u>
Epiall 1961	ROG	BS502519	Epoxy/mineral/glass, granular molding compound, formerly designated Epiall 1906L. Used for JPL IC modules. <u>Notes A6 and B3.</u>

*DuPont Delrin - Acetal Polymer (Polyoxymethylene)

**Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-14. MOLDED PARTS AND MOLDING COMPOUNDS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Fluorocarbon (Teflon), FEP	DUP _a	ASTM D2116 ASTM D3368	Fluorocarbon sheet and film, molding and extrusion. <u>Notes A1 and B1.</u>
Fluorocarbon (Teflon), TFE	DUP _a	ASTM D1710 MIL-P-19468 MIL-P-22296 MIL-P-22241	Fluorocarbon extrusion, molding, rods, tubes and sheet, molded or skived. <u>Notes A1 and B1.</u>
Kel-F 81 Grades 6050, 6061, 6062	MMM _b	BS502560 MIL-P-46036	Polychlorotrifluoroethylene compound. Must call out grade for specific applications. Grades 6050, 6061 and 6062 only available. Glass filled Kel-F no longer produced. Service temperature range: -240° to 204°C(-400° to 400°F). Used for valve seats, seals, films, gaskets, bearings, and stock shapes (rods, etc.). <u>Notes A1 and B1.</u>
Kynar 460	ELF	BS504194	General purpose polyvinylidene fluoride plastic. <u>Notes A1 and B2.</u>
Lexan*	GEC _a	BS502527	Polycarbonate resin from bis-phenol A. Lexan 121 - low melt viscosity Lexan 141 - medium melt viscosity Lexan 101 - high melt viscosity Service temperature: -40° to 121°C(-40° to 250°F). Becomes brittle at lower temperatures. Parts can be bonded with adhesives such as epoxies and urethanes. <u>Notes A1 and B4.</u>
Meldin 6000 (Vespel)	DIC	BS513159	A lubricant filled plastic (polyimide) similar to Vespel SP-3 for space environment. Can be obtained with 15% graphite fill; can also be obtained with 30% Teflon fill. <u>Notes A1 and B1.</u>
Polysulfone Thermoplastic P-1700 P-1710 P-3500	AMO	BS502603	Polysulfone compound. Type I - Molding grade - transparent (P1700 Natural 11) Type II - Molding grade-opaque (P-1710 Natural 15) Type III- Extrusion grade - transparent (P-3500 Natural 11) <u>Notes A1 and B2 for all types.</u>

*G.E. Lexan - polycarbonate polymer from bis-phenol A.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-14. MOLDED PARTS AND MOLDING COMPOUNDS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Rexolite 1422	CLP	BS502535 L-P-516 Type E-2	Cross-linked styrene; used for coil forms, insulators, spacers. Operating temperature range: -75 to 100°C (-103 to 212°F). Produced in sheet form only. <u>Notes A1 and B3.</u>
Rexolite 2200	CLP	BS502536 L-P-516 Type E-2	Cross-linked styrene with fiberglass reinforcement; used for RF connectors adapters. Produced in sheet form only. <u>Notes A4 and B3.</u>
Spectralon	LAB	— *	Material is a sintered polytetrafluoroethylene (PTFE). The molded material is used as a diffuse reflectance standard for calibration of spectrophotometers, reflectometers, integrating sphere systems, and standards for remote sensing. Vacuum bakeout at 90°C (194°F) for 24 hours is required for UV stability. Specify grade as required. <u>Notes A1 and B1.</u>
Vespel SP-1	DUP _c	BS502655	Aromatic polyimide; Dupont supplies basic shapes and machined items under the trade name "Vespel." Unfilled base resin designed to operate continuously from cryogenic temperatures to 288°C (550°F) with short term use to 482°C (900°F) and above. <u>Notes A1 and B2.</u>
Vespel SP-3	DUP _c	BS505776	Aromatic polyimide/molybdenum disulfide filled (15% by weight MoS ₂). Provides maximum wear and friction resistance. Used for nonlubricated seals and bearings in vacuum environment. <u>Notes A1 and B2.</u>
Vespel SP-21 Vespel SP-22	DUP _c	BS513159	Aromatic polyimide/graphite filled. Used for seals, gaskets, bushings and washers in continuous use over a wide temperature range up to 260°C (500°F). SP-21 is 15% by weight graphite filler; SP-22 is 10% by weight graphite filler; materials produce lowest coefficient of friction. <u>Notes A1 and B2.</u>

* Specification could not be found

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-15. POTTING EMBEDMENTS AND ENCAPSULANTS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Conathane EN-11	CON	BS515389	A two component, highly flexible liquid polyurethane potting and encapsulating compound. Used also to conformally coat PWB's and for potting of high voltage power supplies. Translucent or black. $T_g^* = -59^\circ\text{C}(-74^\circ\text{F})$. <u>Notes A1 and B3.</u>
CV 2510 Resin CV 2510 Catalyst	MGN	BS514364	A white two-part RTV silicone rubber with controlled volatility and low outgassing. Primer may be required to achieve good adhesion. A substitute for RTV 566 A/B. Room temperature cure. Used with CAB-O-SIL filler for sealing of subassembly mounted connectors. See D8208, Section 3.18. Operating temperature range: -115 to $260^\circ\text{C}(-175$ to $500^\circ\text{F})$. <u>Notes A1 and B2.</u>
CV 2942	MGN	— **	A two-part, gray, thermally conductive RTV silicone. Formulated to cure with addition of heat to eliminate flow and separation. Provides heat transfer between electrical/electronic components and their heat sink. Note: CV-2942 will cure in contact with most materials except butyl and chlorinated rubbers and some RTV silicones. A MNC SP135 primer is recommended. Operating temperature range: -65 to $250^\circ\text{C}(-85$ to $482^\circ\text{F})$. Cures in 7 days at room temperature. <u>Notes A1 and B2.</u>
DC 6-1104	DCC	BS506319	Controlled volatility sealant, one component, non-slump, RTV. Use for stress relief of electronic components. Cures at room temperature. See D8208, Section 3.18. <u>Note A1.</u>

* T_g - glass transition temperature.

**Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-15. POTTING EMBEDMENTS AND ENCAPSULANTS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
DC 93-500	DCC	BS504221	Space-grade encapsulant, transparent, room temperature curing solventless silicone designed for potting, filling, embedding and encapsulating electronic equipment for use in space environment. Used where high temperature post cure is not feasible. Also used for bonding glass covers for solar cells. Embedded parts can be visually inspected. Retains good properties from -65 to 200°C (-85 to 392°F). Low shrinkage during cure. <u>Notes A1 and B2.</u>
Eccobond 104	ECI GWR	BS502568	A two-part epoxide adhesive used for high temperature spot terminal insulation board bonding only. Requires elevated temperature cure. For high temperature use above 204°C (400°F); post cure at 260°C (500°F). <u>Notes A1 and B3.</u>
Epon 828/ Versamid 140	SCA HKL	BS502506 BS505785	Epoxy/polyamide resin system. Versamid 140 is designed for use with solid or liquid epoxy resins to give tough, chemical resistant thermoset coatings. Cures at room temperature. Mixture is low viscosity, translucent in color. Mix and apply per FS513166. <u>Notes A1 and B3.</u>
Hysol EPK 1C	HYS	BS515787	A general purpose two-part adhesive/sealant; for wiring board hole filling. Hardens within 24 hours and fully cured in 7 days. Used to fill plated-through holes in PWBs and holes electrically isolated from circuitry. Also bonds metals, glass, ceramics, and graphite epoxy composites. Operational temperatures from -46 to 149°C (-50 to 300°F). See D-8208, Section 3.18. <u>Notes A1 and B4.</u>
PR1527 A/B	PRC	BS502679	Opaque, polyurethane, two-part resin; used for potting of subminiature rectangular and circular connectors. Also potting of harness mounted connectors. Supplied in frozen cartridges. Not recommended for applications requiring low outgassing. See D-8208, Section 3.18. <u>Notes A4 and B3.</u>
RTV 11 (DBT)* T-12 Catalyst	GEC _b MTC	BS502611	Low viscosity, two-part, white silicone rubber compound; used for casting insulation strips. <u>Notes A4 and B2.</u>

*Dibutyl tin dilaurate; also called thermolyte "T-12" or "DBT".

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-15. POTTING EMBEDMENTS AND ENCAPSULANTS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
RTV-60 T-12 (DBT*) Catalyst	GEC _b MTC	BS502511 BS502698	Medium viscosity, two-part, red silicone rubber compound; used for coating of electrical conductors exposed to ultraviolet radiation. See D-8208, Section 3.18. Not recommended for low outgassing applications. Requires thermal-vacuum bakeout. <u>Notes A4 and B2.</u>
RTV 566 A/B	GEC _b	BS504228	Moderate viscosity, controlled volatility, red, two-part silicone rubber compound. Note: For stress relief transformers; CAB-0-SIL added. See D-8208, Section 3.18. <u>Notes A1 and B2.</u>
Scotchcast 235 A/B	MMM _c	BS502595	Low viscosity, reddish-brown epoxy resin; used for impregnation of transformers and inductors. See D-8208, Section 3.18. Requires thermal-vacuum bakeout. <u>Notes A4 and B3.</u>
Scotchcast 241 A/B	MMM _c	BS502574	Moderate viscosity, dark brown epoxy resin; used as an encapsulant, and for embedment of inductors. See D-8208, Section 3.18. Requires thermal-vacuum bakeout. <u>Notes A4 and B3.</u>
Scotchcast 280 A/B	MMM _c	BS505777	Low viscosity, amber unfilled epoxy resin, semiflexible; used for impregnation of transformers and inductors. See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Scotchcast 281 A/B	MMM _c	BS502547	Moderate viscosity, cream colored, semiflexible filled epoxy resin; used for impregnation and embedment of transformers and inductors. See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Scotchcast 282 A/B	MMM _c	BS505778	High viscosity, brown, thixotropic, semiflexible filled epoxy resin; used for conformal encapsulation of conductors. <u>Notes A2 and B3.</u>

* Dibutyl tin dilaurate; also called thermolite "T-12" or "DBT".

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-15. POTTING EMBEDMENTS AND ENCAPSULANTS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Scotchweld 2216 B/A CAB-0-SIL Eccospheres	MMM _a CAB EMC	BS515871 BS502697 BS515845	A two-part, 100-percent solids epoxy adhesive containing Eccospheres and CAB-0-SIL. An anti-slump semi-rigid spot bonding material for electronic parts and wire bundles. See D-8208, Section 3.18. Replaces 2216 B/A for this application. <u>Notes A1 and B3.</u>
Solithane 113* Catalyst C-113-300 Catalyst Tri-Isopropanol Amine (TIPA)	UNC DOW	BS502695 BS506323	Used for potting of subassembly mounted connectors. See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Solithane 113* Catalyst C-113-300 Catalyst T-12 Aluminum Oxide	UNC MTC	BS502695 BS502698	Thermally conductive material for electronic components. See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Solithane* 113/C113-300 Colloidal Silica (CAB-0-SIL) T-12 (accelerator)	UNC CAB MTC	BS502695 (Resin and Catalyst) BS502697 (Filler) BS502698	High viscosity mixture of urethane resin, colloidal silica filler and catalyst; used for spot bonding and viscoelastic damping, and for electrical component bonding. See D-8208, Section 3.18. <u>Notes A1 and B3.</u>
Stycast 1090/11	GWR	BS502526	High viscosity epoxy resin for electronic module embedment. This material is a hollow glass spheres filled, black, light weight syntactic foam. Used for encapsulation of welded or soldered electronic modules. Cures at 82°C(180°F). See D-8208, Section 3.18. <u>Notes A2 and B3.</u>

*For applications below -5°C(23°F) see Materials or Packaging Engineers

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-15. POTTING EMBEDMENTS AND ENCAPSULANTS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Stycast 1090/24LV	GWR	BS513312	High viscosity epoxy resin, hollow glass sphere filled, black, light weight syntactic foam. Used for encapsulation of welded or soldered electronic modules. Can be cured at room temperature. For optimum outgassing properties, the material should be cured at 66°C(150°F). <u>Notes A2 and B3.</u>
Stycast 2850FT/24LV	GWR	BS513151	A two-part, 100-percent solids, high thermal conductivity, low thermal expansion, epoxy casting resin. Use for applications requiring good electrical insulation and heat transfer. Can be cured at room temperature. Designed for temperature range from -270 to 120°C(-454°F to 248°F). <u>Notes A1 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-16. SHRINKABLE MATERIALS (TUBING AND ELECTRICAL INSULATION)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Chemfluor Teflon (TFE) ⁽¹⁾	NPP	MIL-I-23053/12	A flexible, natural or colored spaghetti-like tubing. Used as a flexible slip-on insulation in electrical and electronic components. Used in a wide range of applications. Beware of cold flow tendencies of Teflon. Teflon requires special treatment for bonding. Continuous use temperature: -70 to 260°C(-57 to 500°F). <u>Notes A1 and B1.</u>
Expanded Tubing Teflon (TFE)	PNT	MIL-I-23053/12	A translucent, flexible, and heat resistant shrink tubing. Used as insulation for electrical components such as wire connectors, terminals, and semiconductors. Also used to encase square, round, or irregular shapes such as rollers or machined parts and harness assemblies. Continuous use temperature: -70 to 260°C(-57 to 500°F). <u>Notes A1 and B1.</u>
Penntube II-SMT	PNT	MIL-I-23053/11 BS502556	A transparent, natural or light blue modified Teflon (FEP) shrinkable tubing. Used as insulation for soldered joints, parts, components and plastic or metal fittings. Shrink temperature: 150°C(302°F). Temperature range, continuous use: -70 to 200°C(-57 to 392°F). <u>Notes A1 and B1.</u>
Shrinkable Mylar ⁽²⁾	PPG SIC	BS502644 MIL-I-23053/7	A thin film polyester tubing; used for mechanical and electrical protection for solder joints. Shrinkage starts at 100°C(212°F). Service temperature is -60° to 150°C(-76° to 302°F) continuous. Diameter to be specified. <u>Notes A1 and B3.</u>
Teflon (Hookup Wire)	See Comments	SAE AMS 3653 SAE AMS 3654 SAE AMS 3655	Teflon TFE (PTFE - Polytetrafluoroethylene). A high temperature, flexible, extruded coating. Used as insulation for electrical/electronic interconnect wiring over a wide range of operating conditions. Beware of cold flow. Continuous service temperature: -70 to 200°C(-94 to 500°F). Procure per QPL-MIL-W-22759. <u>Notes A1 and B1.</u>

⁽¹⁾Polytetrafluoroethylene⁽²⁾Polyethylene terephthalate or polyester

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-16. SHRINKABLE MATERIALS (TUBING AND ELECTRICAL INSULATION) (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Tefzel (Hookup Wire)	See Com- ments	SAE AMS 3533	Tefzel is an ethylene-tetrafluoroethylene (ETFE) copolymer. A tough, high impact resistant, extruded coating. Used as insulation for electrical/electronic interconnect wiring over a wide range of operating conditions. Procure per QPL-MIL-W-22759. Stripping difficult; exhibits better cold flow than Teflon. Continuous operating temperature is -70 to 200°C (-94 to 392°F). <u>Notes A1 and B1.</u>
TFE (tubing)	RAK	MIL-I-23053/12	Clear thin film tubing, TFE fluorocarbon, used for mechanical and electrical protection for solder joints. Shrinks at 250°C (482°F). Continuous operating temperature is -67° to 250°C (-89° to 482°F). <u>Notes A1 and B1.</u>
Thermofit Kynar RT850	RAK	BS502579 MIL-I-23053/8	Tubing, polyvinylidene fluoride (PVDF); used for mechanical and electrical protection for connector terminals. Minimum shrink temperature is 175°C (347°F). Continuous operating temperature is -55° to 175°C (-67° to 347°F). <u>Notes A1 and B2.</u>
Thermofit RNF-100 Type 2, Clear	RAK	BS502508 MIL-I-23053/17	Thin film polyolefin tubing; used for insulation of mechanical and electrical connector terminals. For transparent covering of capacitors, resistors, batteries, etc. High outgassing. Minimum shrink temperature is 121°C (250°F). See D-8208, Section 3.18. Continuous operating temperature is -55° to 135°C (-67° to 275°F). <u>Notes A4 and B3.</u>
Thermofit RT 1146	RAK	MIL-I-23053/13 MIL-R-46846 Class I Type 3	A flexible, fluoroelastomer (VITON) heat-shrinkable tubing. Used as insulation for electrical components and wiring assemblies. Minimum shrink temperature is 175°C (347°F). Recommended use temperatures between -40 and 200°C (-40 and 392°F). <u>Notes A1 and B1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-17. TAPES

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Fibrebat I 2510	MMM _c	BS502588	Nonwoven, white polyester cloth, 0.14 mm (0.0055") thick, used for transformer winding insulation and coils ST10022-7, -8, -9. Use in temperature Class B and F coils. Class B is 125°C(250°F). Class F is 150°C(302°F). See D-8208, Section 3.13. <u>Notes A1 and B3.</u>
Mystik 6401 is now CT941	TLC	BS502688	0.025 mm (0.001 inch) polyester film base, acrylic adhesive, pressure sensitive, transparent, and solvent resistant. Electrical grade; insulation class: 130°C(266°F). <u>Notes A1 and B3.</u>
Mystik 7000 is now CT900	TLC	BS502598 MIL-I-19166 Type 10 mil	Glass cloth base, pressure sensitive silicone adhesive; limited usage due to high outgassing properties (ST10021). Operating temperature range: -60 to 260°C(-75 to 500°F). Electrical grade class: 180°C(356°F). Total thickness: 0.25 mm (0.010 inch); backing thickness: 0.114 mm (0.0045 inch). <u>Notes A4 and B2.</u>
Mystik 7020 is now CT920	TLC	BS502549	Woven cloth, rubber base thermosetting adhesive, and winding insulation tape; limited usage due to high outgassing properties. High tack, high adhesion. Electrical grade class: 130°C(266°F). Tape thickness: 0.19 mm (0.0075 inch), backing thickness: 0.12 mm (0.0046 inch). <u>Notes A4 and B2.</u>
Mystik 7021 is now CT921	TLC	BS504229	Electrical grade, glass fabric, pressure sensitive acrylic adhesive; low contamination, general purpose. Insulation class: 155°C(311°F). Used for coil and transformer insulation, high temperature duct tape, harness wrap and insulation of heater coils. <u>Notes A1 and B2.</u>
Mystik 7300 is now CT 901	TLC	BS502599	0.025 mm (0.001 inch) mylar film base, green 0.076 mm (0.003 inch) silicone adhesive, pressure sensitive; limited usage due to high outgassing properties. Operating temperature up to 196°C(385°F). Used for circuit board masking, capacitor wrap, high temperature lead wire hold-down, and toroidal coil outer wrap; stable at 196°C(385°F). <u>Notes A4 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-17. TAPES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Mystik 7367 is now CT967	TLC	BS506312	0.025 mm (0.001 inch) polyimide film base (Kapton), acrylic adhesive, pressure sensitive; used for solar panel edge closure. Tape is also used for masking of printed circuit boards. Electrical grade class: 155°C(311°F). Total thickness: 0.08 mm (0.003 inch). Backing thickness: 0.025 mm (0.001 inch). <u>Notes A1 and B4.</u>
Mystik 7452 and 7453 are now CT625	TLC	BS502649	Aluminum foil base, 0.08 mm (0.003 inch) acrylic adhesive, pressure sensitive; used for RF shielding. <u>Notes A1 and B2.</u>
Scotch Brand No. 5 Electrical Tape	MMM _c	MIL-I-15126 Type MFT 2.5	Polyester film base, thermosetting acrylic adhesive, transparent, solvent resistant; for use in coil and capacitor holding applications. Temperature class: 130°C(266°F). Maximum temperature usage: 175°C(347°F). Also see note below. <u>Notes A1 and B3.</u>
Scotch Brand No. 27 Electrical Tape	MMM _c	ST10859	White woven glass base, thermosetting adhesive; used for winding insulation tape (ST10859). Temperature class: 130°C(266°F). Maximum temperature usage: 175°C(347°F). See D-8208, Section 3.13. <u>Notes A4 and B4.</u>
Scotch Brand No. 56 Electrical Tape	MMM _c	ST11099	Polyester film base, thermosetting adhesive (yellow), used for inductor solder joint insulation, tape and fastening; limited usage due to high outgassing properties. Temperature class: 130°C(266°F); maximum temperature usage: 175°C(347°F). <u>Notes A4 and B3.</u>
Scotch Brand No. 213	MMM _c	— *	A high-heat resistant crepe paper/cured rubber adhesive tape. A highly transfer-resistant adhesive. Can generally be used in bake cycles up to 177°C(350°F) for one hour, with clean, easy removal. Used for masking off areas for rework; leaves no residue. <u>Notes A4 and B3.</u>

*Specification could not be found.

Note: A complete list and description of 3M tape products may be found in the following brochures: Electrical-No.80-6106-5463-6(612 DPI); for industrial tapes; 70-0703-2849-0(1212) BE.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-17. TAPES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Scotch Brand No. 415	MMM _d	BS506316	Mylar base, double-sided adhesive, pressure sensitive; used for flat pack mounting and IC stick modules. <u>Notes A1 and B3.</u>
Scotch Brand No. 425	MMM _d	Same as BS502649	A dead soft aluminum foil (1145.0) tape with a transparent acrylic adhesive. Used for general purpose highly reflective aluminum surface, providing excellent radiation for both heat and light. Same as Mystic 7452 or CT625. <u>Notes A1 and B3.</u>
Scotch Brand No. 480	MMM _e	GSFC-TLS-PR-7324-01	A transparent polyethylene film tape with a long aging transparent acrylic adhesive. Has low temperature characteristics. Used for lifting particles from flight hardware to perform microscopic analysis for determining cleanliness of hardware. Can also be used for splicing. <u>Notes A4 and B3.</u>
Scotch Brand No. 850	MMM _e	L-T-100, Type I	Clear polyester film. Use where chemical and thermal stability are required. Temperature range from -51° to 149°C (-60° to 300°F). <u>Notes A1 and B3.</u>
Scotch Brand No. 850, Metallized	MMM _e	BS502609 L-T-100 Type II	Metallized polyester film base; used for sealing edges of thermal blankets. Specify color; silver, aluminized, or gold. Remains flexible from -51° to 144°C (60° to 300°F). <u>Notes A1 and B3.</u>
Scotch Brand No. 853	MMM _e	L-T-100 Type I	Clear, polyester film; used where chemical and thermal stability is required. Solvent resistant. <u>Notes A1 and B3.</u>
Scotch Brand No. 966	MMM _g	BS513520	0.05 mm (0.002 inch) acrylic, pressure sensitive adhesive transfer tape. Good ultraviolet (UV) resistance and low outgassing property. Use for laminating Multilayer Insulation (MLI) thermal control blankets. Continuous service temperature is 149°C (300°F); maximum short term is 232°C (450°F). <u>Notes A1 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-17. TAPES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Scotch Brand No. 1181	MMM _c	— *	A copper-backed electrically conductive acrylic electromagnetic interference (EMI) shielding tape for general spacecraft use. Foil thickness 0.076 mm (0.003 inch). Electrical resistance through tape: .032 ohms cm ² (.005 ohms/in ²). Service temperature: 155°C(311°F). Notes A2 and B3.
T-25	FRA	— *	Copper-polyester film electrostatic shielding tape; a pressure-sensitive acrylic adhesive. 0.025 mm (0.001 inch) mylar film is laminated to one side of 14 grams (1/2 oz.) copper foil. Designed as a non-shorting shielding wrap between primary and secondary windings on bobbin-wound and toroidal coils and transformers. Insulation class B: 130°C(266°F). Notes A6 and B4.
T-26	FRA	— *	Polyester-copper polyester electrostatic shielding tape. A 0.025 mm (0.001 inch) mylar film laminated to both sides of a 14 grams (1/2 oz.) copper foil. Designed as a non-shorting inner or outer shielding wrap for bobbin-wound and toroidal coils and transformers. Insulation class B; 130°C(266°F). Notes A6 and B4.
Tape, Silicone, Press. Sensitive, CHR No. 23816- HC CT 910	CHR _c TLC	BS516205 — *	A silicone pressure sensitive adhesive on one side of flame retardant silicone rubber impregnated fiberglass. It has a removable protective Holland cloth (HC) liner. Temperature range: -54° to 232°C(-65° to 450°F). Intermittent temperature to 288°C(550°F) Maximum temperature: 538°C(1000°F) for approximately one minute. NOTE: CT 910 is a comparable tape. Notes A6 and B4.
TEMP-R-TAPE M69	CHR _c	— *	A transparent 0.025 mm (0.001 inch) polyester tape with acrylic adhesive on both sides. Used for bonding applications where moderate strength and uniform bond thickness are required. For bonding e.g., aluminized Kapton film, silver Teflon film, etc. Service temperature: 130°C(266°F). Notes A1 and B3.

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-17. TAPES (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
TEMP-R-TAPE K-350	CHR _b	MIL-T-47325	A pressure sensitive tape on Dupont's 0.025 mm (0.001 inch) polymer Kapton film having excellent electrical and mechanical properties. This tape has the highest electrical strength for a single insulating wrap. The adhesive is a silicone polymer with a temperature range of -75 to 260°C (-103 to 500°F). The adhesive can be thermoset for greater resistance to solvents, Cure is 4 hours at 205°C (400°F). <u>Notes A1 and B1.</u>
TEMP-R-TAPE TV-350	CHR _b	BS502600 MIL-I-23594	A Teflon pressure sensitive insulating tape with a silicone adhesive. Functional through a temperature range of -73 to 260°C (-100°F to 500°F). This material has high resistance to chemicals. See D-8208, Section 3.13; also used for insulation and abrasion protection of cabling (ST10020); insulation class: 180°C (311°F) <u>Notes A4 and B3.</u>
TEMP-R-TAPE HM430	CHR _b	ASTM D2686	A low friction surface, Teflon (TFE), transparent tape with acrylic adhesive. Excellent electrical properties and temperature resistance. Used for electrical insulation and general spacecraft applications. Can also be used as a masking tape for protection of surfaces during painting, epoxying, conformal coating and potting. Maximum service temperature: 155°C (311°F). <u>Notes A6 and B4.</u>
Trimtex Tape (Was Dacron Kappa)	ELI	— *	Woven polyester tape, used for transformer winding insulation, 0.127 mm (0.005") thick. Thermal endurance (uncoated): 130°C (266°F). Thermal endurance class F varnish coated: 155°C (311°F). See D-8208, Section 3.13. <u>Notes A1 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Aeroglaze A276	LOR	BMS 1090A (Boeing)	A single component polyurethane coating, with white, high gloss and good thermo-optical stability. Coating has good abrasion resistance. Cure: 15 days at room temperature plus 48 hours at 95°C (240°F). $\alpha_s = 0.25$; * $\epsilon_n = 0.88$. * Requires Chemglaze 9924 wash primer for metal substrate and Chemglaze epoxy metal primer 9922 for steel to improve adhesion. <u>Notes A2 and B3.</u>
Aeroglaze Z306 (was Chemglaze Z306)	LOR	BS506303 ASTM D16 TYPE II	A single component flat black aromatic polyurethane base flexible paint. 3-4 hours drying time between coats; primarily used on surfaces requiring high thermal emittance. Applied as a thermo-optical coating on spacecraft. $\alpha_s \leq 0.95$; $\epsilon_n = 0.90$. Maximum service temperature 150°C (300°F). Total Mass Loss (TML) = 1.00%; Volatile Condensable Material (VCM) = 0.02% <u>Notes A2 and B3.</u>
Aeroglaze Z306 with Chemglaze 9929 A/B Primer	LOR	BS506303 (paint) BS506315 (primer)	Two-part epoxy primer coat followed with top coating of flat black polyurethane paint; 2 hours minimum, 20 hours maximum dry time for primer at 25°C (75°F). Primarily used for same applications as paint alone but where optimum adhesion is required such as internal optical cavities. Flight hardware may require additional thermal-vacuum treatment (depending on lot, usage and location). Maximum temperature usage: 177°C (350°F). $\alpha_s = 0.95$; $\epsilon_n = 0.91$. NOTE: 9929 A/B replaces 9922 A/B. 9929 A/B to be tested and qualified. <u>Notes A2 and B3.</u>
Aeroglaze Z307	LOR	ASTM D16 Type II	A thermo-optical electrically conductive flat black polyurethane coating. A single component system. Surface resistivity is $10^2 - 10^3$ ohms/cm ² (0.00075 to 0.0015 inch thickness). $\epsilon_n = 0.89$ $\alpha_s = 0.97$. Tack free in 2-3 hours at room temperature. <u>Notes A1 and B3.</u>

* α_s = absorptance; ϵ_n = emittance

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Aeroglaze Z3306	LOR	ASTM D16 Type II	A low VOC, single component, flat black, moisture-curing aromatic polyurethane. Formulated to resist corrosion, abrasion, chemical attack and impact. Designed for substrates used in spacecraft. No primer required. It is essentially the same as Z306 only it meets the Calif. AQMD air pollution requirements. Cure time: 6 hours at room temperature permits handling. $\epsilon_n = 0.89$ $\alpha_n = 0.94$. * Maximum temperature usage: 150°C(300°F). <u>Notes A2 and B3.</u>
AKZO 443-1-500T (Formerly Sikkens/Bostic)	AKZ	BS502652	White, TiO ₂ pigmented, two-part epoxy base paint; 1 hour dry time between coats; used primarily on surfaces requiring low solar absorptance and high thermal emittance. Tough durable surface, solar panel. Flight hardware may require additional thermal-vacuum treatment. Operating temperature range: -73 to 176°C(-100 to 350°F). <u>Notes A4 and B3.</u>
AKZO 463-3-8 (Formerly Sikkens/Bostic)	AKZ	BS501403	System D per FS501424. Flat black, carbon pigmented, two-part epoxy base semiflexible paint; no primer required; 1 hour dry time between coats; primarily used on surfaces requiring high thermal emittance properties; flat black coating with a diffuse reflective behavior. Structural surfaces and solar panel. Flight hardware may require additional thermal-vacuum treatment. Operating temperature range: -73 to 176°C(-100 to 350°F). <u>Notes A2 and B3.</u>
AKZO 463-6-14 (Formerly Sikkens/Bostic)	AKZ	BS513077	System H per FS501424. Flat black, electrically conductive, semiflexible temperature control paint. Two-part, specially pigmented, epoxy base paint. No primer required. Use on surfaces requiring high thermal emittance or low light reflectance as well as electrical conductivity. Cure at room temperature. Flight hardware may require additional thermal-vacuum treatment. Operating temperature range: -73 to 176°C(-100 to 350°F). <u>Notes A4 and B3.</u>

* α_n = absorptance; ϵ_n = emittance

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Chemglaze Z004	LOR	BS513076	Clear, highly flexible unpigmented, one-part moisture-curing polyurethane. Primer is required. Material is usually modified by the addition of a conductive filler in accordance with FS501424 System H to make it electrically conductive. Maximum service temperature is 150°C(300°F). <u>Notes A2 and B3.</u>
Enamel APA-2474 (Formerly VV15966 Form PV100 white)	MRT	BS501404	High temperature flat white, TiO ₂ pigmented, one-part silicone alkyd paint; 1 hour dry time between coats on surfaces requiring low solar absorptance and high thermal emittance properties in environments for short periods up to 204°C(400°F), and extended periods to 149°C (300°F). Used on instruments and louvers. Flight hardware may require additional thermal vacuum treatment. <u>Notes A2 and B2.</u>
GF 580	JPL	BS513315	High temperature black, electrically conductive thermal control paint, consisting of a combination of graphite powder and phenyl silicone and metallic oxides. No primer required. For use between -195 and 649°C(-320 and 1200°F). Requires elevated temperature cure. Also requires thermal-vacuum bake-out at 66°C(150°F) for 24 hours to meet outgassing requirements. <u>Notes A2 and B2.</u>
IR-81-E	LMC	FS502757	Vacuum deposited thin gold optical coating used for optical surfaces; high transmission, low emittance. It is also a transparent electrically conductive infrared reflective coating. <u>Notes A1 and B1.</u>
Iron Titanate	WCS CEX NLI	BS513171	Granular, iron-black powder. Apply by plasma spraying to metal substrates resulting in a black, heat resistant, stable, electrically conductive thermooptical coating. α/ϵ^* = 1.05; service temperature range: -195 to 649°C(-320 to 1200°F). <u>Notes A1 and B1.</u>

* α/ϵ = absorptance/emittance

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Laminar X-500, No. 8G23	DCM	BS501406	Flat green, CrO ₂ pigmented two-part polyurethane paint; contains Teflon filler. 1 hour dry time between coats; used on surfaces to maintain a relatively constant absorptance/emittance when exposed to ultraviolet radiation. Flight hardware may require additional thermal-vacuum treatment. Requires elevated temperature cure. Operational temperature is from -73 to 121°C (-100 to 250°F). <u>Notes A2 and B3.</u>
Laminar X-500, No. 4B1	DCM	BS502653	Gloss black, pigmented, two-part polyurethane paint; 1 hour dry time between coats; high-gloss black coating with specular reflectivity behavior suitable for solar panels and light baffles, exposed electrical parts and connections. Flight hardware may require additional thermal-vacuum treatment. Requires elevated temperature cure. Operational temperature is from -73 to 121°C (-100 to 250°F). <u>Notes A2 and B3.</u>
MH-11Z	ITT-JPL	BS513199, Type II	Flat black electrically conductive thermal control paint, consisting of a combination of graphite, carbon powder, potassium silicate, zinc oxide and water. No primer required. For use between -195 and 538°C (-320 and 1000°F). Cure requires only air drying at room temperature. <u>Notes A1 and B1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
Nonmagnetic, electrically conductive thermal control paint	JPL	BS513330	Nonmagnetic, electrically conductive, flat black thermal control paint, consisting of a polyurethane resin formulation and graphite powder. No primer required. Type I is formulated for application on metallic substrates. Type II is formulated for application over dielectric substrates such as epoxy, silicone or phenolic fiberglass laminates and ceramics. For use at temperatures between -195 and 177°C (-320 and 350°F). Can be cured at room temperature or at 65°C (150°F). <u>Notes A1 and B3.</u>
NS43G	SCC	BS516165	A white semi-brittle ZnO + Al ₂ O ₃ pigment in potassium silicate binder. Requires special substrate cleaning, application and spraying operations. Thermooptical properties: $\alpha_s = 0.30$ $\epsilon_n = 0.90$.* Apply per FS516163. <u>Notes A1 and B1.</u>
PCBZ	MAP	— **	Base Coat: metallic flake pigment in purified silicone binder. Top coat: zinc orthostannate pigment in purified silicone binder; special surface treatment and spray operations required. Thermooptical properties: $\alpha_s = 0.26$, $\epsilon_n = 0.84$. <u>Notes A1 and B1.</u>

* α_s = absorptance; ϵ_n = emittance

**Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-18. TEMPERATURE CONTROL COATINGS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
S-13G/LO-1	IIT	MSFC-PROC-1384A	White flexible ZnO pigmented, two part silicone base paint. 1 hour dry time between coats. A resilient coating that will exhibit a low solar absorptance and high thermal emittance, with good resistance to thermal shock and stress. Soiling tendencies are high. Flight hardware may require additional thermal-vacuum treatment. $\alpha_s = 0.20$, $\epsilon_n = 0.90 \pm 0.05$. * Operating temperature range: -195 to 400°C (-320 to 752°F). Not as stable as Zinc Orthotitanate (ZOT). <u>Notes A1 and B2.</u>
Z93	IIT	— **	A white semi-brittle inorganic zinc oxide/potassium silicate base paint for use on surfaces requiring low solar absorptance and high thermal emittance; $\alpha_s = 0.15$; $\epsilon_n = 0.90$. Paint requires special surface preparation. Paint is relatively stable in space environment. <u>Notes A1 and B1.</u>
Zinc Orthotitanate "ZOT" or YB71	IIT	FS511315 (applic.) MSFC-PROC-1494	White inorganic zinc orthotitanate pigmented, potassium silica base paint; primarily used on surfaces requiring low solar absorptance and high thermal emittance. Paint is hard and brittle. Requires special substrate preparation. Maximum service temperature is 1000°C(1831°F). Thermo-optical properties: $\alpha_s = 0.12$; $\epsilon_n = 0.90$.

* α_s = absorptance; ϵ_n = emittance

**Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Antistatic Bagging Material</u> SECO 707	NMX	MIL-B-81705 MIL-STD-1686	Replaces Ameri-Stat 1.5. A sealable transparent bluish color, antistatic shielding multilayered film. Surface resistivity is in the range of 10^{11} to 10^{12} ohms/square. Layers consist of a protective top coat, first metallic layer, polyester film, second metallic layer, and a polyethylene static dissipative film which is heat sealable. Available in various sizes. Use for bagging flight hardware. Not intended for flight use. KSC rating: Acceptable (A) for N_2H_4 and MMH. Material purchased through Baxter Scientific Products (BSP). Notes A1 and B3.
3M2100	MMM _g	MIL-B-81705 MIL-STD-1686	A transparent smoke-gray color antistatic shielding multilayered film, heat sealable. Layers consist of polyethylene film, polyester film, conductive nickel coating and abrasion resistant coating. KSC rating: Acceptable (A) for N_2O_4 , N_2H_4 and MMH. Available in various sizes. Use for bagging flight hardware. Not intended for flight use. Notes A1 and B3.
3M2100E/ 3M2110E	MMM _g	MIL-B-81705 MIL-STD-1686	An improved version of 3N2100. Contains a static-dissipative agent and a crisscross embossed interior grid which is less contaminating. Type 211DE is a reclosable static shielding bag. Available in various sizes. Use for bagging flight hardware. Not intended for flight use. Notes A1 and B3.
<u>Bagging Packaging Material</u> Polyethylene	See Comments	MIL-B-22191	This is a barrier material, transparent, flexible and heat sealable. Intended for packaging of spacecraft components not requiring antistatic handling properties for storage. Packaging affords protection from solid contamination. Specify type and class as called out in the specification. Procure through QPL. Notes A1 and B3.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Catalyst</u> Dibutyl Tin Dilaurate (DBT) (Thermolite 12)	GEC _b GEC _b	BS502698 DOD-D-82727	Catalyst for silicone based compounds for two-part systems. Also used as a catalyst for urethane resins such as Solithanes for conformal coatings. Purchase through R.S. Hughes, Los Angeles, CA 90030. See D-8208, Section 3.13. <u>Notes A1 and B3.</u>
TIPA Catalyst	DOW	BS506323	Triisopropanolamine catalyst used with formulations 8 and 12 of Solithane 113/C113-300. For uses see D-8208, Section 3.18. Procure through Van Waters & Rogers Chemicals, Los Angeles, CA 90023. <u>Notes A1 and B3.</u>
<u>Fillers</u> Aluminum Oxide 325 Mesh or Finer. KNC 3955	ESP	ASTM F7	Aluminum oxide powder, chemically pure 99.999%. Used as a filler for both radiation shielding and thermal conductance. Added to resins as required. <u>Notes A1 and B1.</u>
Colloidal Silica (CAB-O-SIL M5)	CAB	BS502697	Used as thickener for resins, adhesive, sealants and coatings. Concentrations may vary to meet desired requirements. <u>Notes A1 and B1.</u>
Eccospheres SI	EMC	BS515845	Used to control the physical and electrical properties of materials. Also used to produce light weight syntactic foams. Can be combined with adhesives for spot bonding of electronic parts. <u>Notes A1 and B1.</u>
Glass Beads (Solid) (Silica) Glass Beads (Solid) Flexolite No. 9	POT FAS	HMS-20-1776A (Hughes)	Silica glass beads used to maintain a uniform bond line in adhesive bonding. Nominal diameter; 0.125 ± 0.025 mm (0.005 ± 0.001 inch). Lot of beads shall be free of contamination. <u>Notes A1 and B1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Fillers, Cont'd</u>	ESP	SAE AMS 7878 (Cobalt-coated powder)	Used for radiation shielding as an additive for resins, adhesives, sealants and coatings. Concentrations used as required. <u>Note A1.</u>
Tungsten Carbide 325 Mesh or Finer			
<u>Fluids</u>			
DC 210H	DCC	BS502562	Silicone fluid for dampers.
DC 510	DCC	BS513529	Dimethyl polysiloxane fluid for devices and controls which require a fluid with a relatively flat temperature-viscosity curve.
<u>Fluxes</u>		MIL-F-14256	
Nonactivated, Rosin	KSD	BS502514, Class 1	Liquid flux; use per D-8208, Section 3.14.
Mildly Activated, Rosin	AMX	BS502514, Class 2	Liquid flux; use per D-8208, Section 3.14.
Acid	MCS	BS502541	Liquid flux; use for stainless steels, nickel kovars and special alloys per FS500441.
<u>Foams</u>			
Eccofoam FPH/FR	ECI	BS513090	Rigid polyurethane (pink), foam-in-place, flame retardant, closed cell foam. Bulk density g/cm ³ : 0.048, 0.128, 0.224 (lb/ft ³ : 3, 8, 14). Service temperature: 107°C(275°F); short term is 163°C(325°F). <u>Notes A2 and B2.</u>
Eccofoam FPH/12-2H FPH/12-6H	ECI	BS502575	Rigid polyurethane (pink) foam-in-place, closed cell foam. (Properties are similar to Eccofoam SH.) Bulk density g/cm ³ : 2H is 0.032 to 0.048; 6H is 0.096 to 0.160 (lb/ft ³ : 2H is 2 to 3, 6H is 6 to 10). Service temperature: 107°C(275°F); short term: 168°C(325°F). <u>Notes A1 and B3.</u>
Eccofoam SH	ECI	BS502640	Rigid polyurethane (pink), prefoamed closed cell foam sheet. Thermal insulation. Bulk density g/cm ³ : 0.032, 0.128, 0.224 (lb/ft ³ : 2, 8, 14). Service temperature: 107°C(275°F); short term: 163°C (325°F). <u>Notes A1 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Foams-Cont'd</u> Last-A-Foam FR 10100	GPM	— *	A flame resistant, rigid polyurethane (isocyanurate) closed cell foam. Density range from 0.1 to 0.32 g/cm ³ (6 to 20 lb/ft ³). Has a continuous operating temperature of 177°C (350°F). <u>Notes A1 and B3.</u>
Rohacell	ROH	MIL-F-46194	Lightweight, rigid polymethacrylimide closed cell foam. Density range from 0.03 to 0.19 g/cm ³ (1.9 to 11.9 lb/ft ³). Operating temperature range from -212 to 177°C (-350 to 350°F). Has high strength-to-weight ratio. Used on spacecraft, missile, aircraft radiation and nucleonics. Foam will not explode in space vacuum. <u>Notes A1 and B3.</u>
<u>Glass</u> Optical Glass	—	MIL-G-174	Fused quartz. Procure to MIL-G-174.
<u>Indicators</u> Fluorescent Indicator (Calcofluor White, RWP Conc)	ACY ₆	BS502696	Fluorescent indicator for conformal coatings.
<u>Lacing Cord</u> Gude-Space	GUD	BS502604 Type 1 18D96 Type 2 21D96 Type 3 26D96 MIL-T-43435 Type II	Dacron, synthetic rubber treated, 18D96, 21D96, 26D96; used for lacing and tying harness and cabling (ST10027). Service temperature: -73 to 177°C (-100 to 350°F). See D-8208, Section 3.12. Color: Natural (white) or black. <u>Notes A2 and B3.</u>

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Lacing Cord,</u> <u>Cont'd</u> Gude-Temp G Lacing Tape	GUD	BS513225	Nomex, self extinguishing flat braided tape, impregnated with a modified nylon polymer. For service in the temperature range of -55 to 260°C (-67 to 500°F) Color: natural, with inter-braided markers. <u>Notes A1 and B3.</u>
<u>Paper</u> Armite Fish Paper	SPL	ASTM D619	Electrical insulation grade. Thickness: 0.13 to 0.76 mm (0.005 to 0.030 inches); limited to transformer use. Use only when completely encapsulated. See D-8208, Section 3.13. <u>Note A6.</u>
Transformer Kraft Paper	CTP	ASTM D619	Thermally upgraded electrical grade; thickness: 0.13 to 0.76 mm (0.005 to 0.030 inches); limited to transformer use. Use only when completely encapsulated. <u>Note A6.</u>
<u>Pigment/Powder</u> Conductex SC Powder	CCC	BS513080	Powdered carbon black used to increase the electrical conductivity of paints and resins. Usually used in the formulation of the primer and topcoat comprising the System F thermal control coating per FS501424. <u>Notes A1 and B1.</u>
Superior Graphite No. 9035 (325 Mesh)	SGC	BS513199	A preferred black electrically conductive graphite pigment added to various resin paint systems to render the paint electrically conductive. Conductivity will vary depending on concentrations used. Used in thermooptical coatings. Graphite 9035 is more effective than Conductex SC for increasing electrical conductivity. <u>Notes A1 and B2.</u>
Zinc Oxide Powder SP-500	NJZ	MIL-Z-37707	A white technical grade powder used as a pigment added to various resin paints systems to achieve required thermooptical properties. Specify calcined material. Lead time required for procurement. Used in the formulation of Zinc Orthotitanate (ZOT) and S-13G/LO-1. <u>Notes A1 and B1.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Radiation Shielding</u> Solithane 113* Catalyst C-113-300 Aluminum Oxide	UNC	BS502695 ASTM F7	For radiation shielding applications and as a thermally conductive material for electrical components. See D-8208, Section 3.13. <u>Notes A1 and B3.</u>
<u>Sleeving</u> Ben-Har Acryl A, B, C & C-2	BHM	BS502645	Acrylic resin coated on fiberglass tubing/sleeving, similar to MIL-I-3190. Only Grade A meets MIL-I-3190/3; Grade A (7000V); B (4000V); C-2 (1500V). AWG 30 to 0. <u>Notes A1 and B3.</u>
Ben-Har 1258	BHM	BS502602	Silicone rubber sleeving/tubing used for abrasion protection and insulation of cabling (ST10032). See D-8208, Section 3.12. <u>Notes A4 and B2.</u>

*For applications below -5° C(23°F) see Materials or Packaging Engineers.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Sleeving, Cont'd</u> S-1600	VAR	MIL-I-3190/2 MIL-I-3190/3	Braided "S" Glass sleeving, heat treated (grade HT); also grade HO with acrylic coating, and grade HM, an oleoresinous coating. (For glass only.) See D-8208, Section 3.12. <u>Notes A1 and B2.</u>
Teflon Insulation	DUP.	MIL-I-22129	TFE, fluorocarbon, natural color, AWG 30 to 0; used for insulation of part leads (ST10033). See D-8208, Section 3.12. Specify and procure per QPL. <u>Notes A1 and B1.</u>
<u>Solvents, Paint</u> Aeroglaze 9958 Thinner	LOR	MIL-C-81722 Type I	For Z, H, A and V series coatings. A blending of ester and aromatic solvents. Normal use is 5-15% as a thinner. Use in place of 9951 if a MIL-Spec thinner is required for coating. <u>Notes A4 and B3.</u>
Chemglaze 9951 Solvent	LOR	BS513156	Standard Chemglaze thinner for Z, H, A, and V series coatings. A blend of ester and aromatic solvents. Normal use is 5-15% as a thinner. <u>Notes A4 and B3.</u>
Chemglaze 9953 Epoxy Primer Solvent	LOR	Lord Bulletin DS10-7067	A blend of alcohol and aromatic solvents for thinning and cleanup of 9929 epoxy primer only. Must not be used for thinning Chemglaze or Aeroglaze coatings. For primer use only. <u>Notes A4 and B3.</u>
<u>Thread</u> Dacron (Star Ultra Dee)	CAM	BS505782	Sizes 12, 16 and 24 changed to sizes 138, 92 and 69, bonded thread condition (DB) silicone finish; twist and color shall be called out. (S) right twist; (Z) left twist. <u>Notes A1 and B3.</u>
Nomex MH-69BS	BLU	BS506324 A-H-50195 (Supersedes MIL-T-43636)	Aramid nonmelting nylon thread, bonded and stretched. Type II size E; plied thread Z. Color to be specified per DOD standard shades for sewing threads. <u>Notes A1 and B3.</u>

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column. Materials with both Notes "A1" and "B1" are preferred.

Section 3.2 NONMETALLIC MATERIALS

Table 3.2-19. MISCELLANEOUS MATERIALS (Cont'd)

DESIGNATION	MFG	MATERIAL SPECIFICATION	COMMENTS ¹
<u>Cable Ties</u> Tefzel Tyrap Ties TYZ 23 M TYZ 25 M TYZ 27 M	TBC	— *	This type of cable tie is used for high strength, low contamination, corrosion resistant, radiation stable, and wide temperature range bundling applications. Temperature Range: -46 to 221°C(-50 to 430°F). Continuous use: 150°C(302°F). <u>Notes A1 and B1.</u>
<u>Tie Cord</u> Nylon, Seine Twine	BLU	BS505784	White or natural color. 100% continuous filament nylon. Sizes vary from 3 through 168 depending on minimum breaking strength (lbs) required. <u>Note A4 and B3.</u>
<u>Wiping Cloth</u> Coventry "C" Prime Part #6209C and 6212C	CMC	— *	Replaces Kendall Cleancare. Material has a low nonvolatile residue and low particulate. Used in wiping spacecraft and flight hardware. Removes oils and contaminants. A super clean wiping material. Purchase through A.J. Reynolds, Torrance, CA 90505. NOTE: Pretest for static charge generation prior to use. <u>NOT FOR OPTICS</u> <u>Notes A4 and B3.</u>
Cleancare (Kendall)	KEN	— *	Replaced by Coventry "C".

*Specification could not be found.

¹See page 3.2-3 for notes prefixed "A" or "B" referenced in this column.
Materials with both Notes "A1" and "B1" are preferred.

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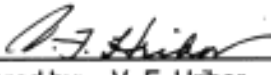
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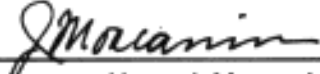
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Section 4.0 - Processes

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SECTION 4.0 - PROCESSES

Table 4-1. ADHESIVE BONDING

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Adhesive Bonding, Electronic Packing and Cabling	D-8208, Section 3.18 FP513414	Formerly DM509306
Adhesive Bonding, Tantalum-Aluminum Laminate	FS511311	For radiation shielding laminates
Adhesive Bonding, Vacuum Bag Method	FS513088	General procedure
Adhesive Bonding of Composite Truss and Boom Structures	FS509340	Calls out surface preparation, primer, adhesive and applications
BR 127 Primer, Preparation and Application of	FS513185	
EA 901/B-1 Adhesive, Preparation and Application of	ZPS-4071-0001	
EA 901/L-3 Adhesive, Preparation and Application of	ZPS-4071-0002	
EA 913/L-3 Adhesive, Preparation and Application of	ZPS-4071-0005	
EA 934 A/B Adhesive, Preparation, and Application of	ZPS-4071-0010	Replaced by EA934 N/A Per FS515056
EA 934 N/A A/B Adhesive, Preparation and Application of	FS515056	Non-asbestos
EA 956 A/B Adhesive, Preparation and Application of	FS513184	General usage
EA 956 A/B Adhesive and Laminating Resin, Detail Specification for	FS513307	Specific instructions for laminating fabrics
EA 9210 Primer, Preparation and Application of	FS509336	
EA 9309 Adhesive, Preparation and Application of	FS509331	
EA9394 A/B Adhesive, Preparation and Application of	FS515060	A new adhesive system to replace EA 934 A/B
EA 9446 A/B Acrylic Adhesive, Application of	FS513533	
Epon 828/Versamid 125, Preparation and Application of	ZPS-4013-0025	

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TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Epon 828/Versamid 140, Preparation and Application of	FS513166	
Epon 828/871/AEP, Preparation and Application of	FS505153	Not recommended Adjacent optical surfaces
Epoxy Resin Stycast 1095/9	FS513309	See "Spot Bonding" Replaced by Scotch-Weld 2216 B/A gray with filler. (BS515846)
FM 37, FM40, FM41, Epoxy Foaming Adhesives, Preparation and Application of	FS513306	
FM 123-LVC Adhesive, Preparation and Application of	FS513310	
Nylon Mounting Pads, Bonding to Composite Space Structures	FS513413	
PLV-2000 Elastomer, Preparation and Application of	FS513523	
Preparation of Surfaces for Adhesive Bonding	FS504508	
Preparation of Test Specimens and Qualification of Adhesives	MMM-A-132	
RTV 566 A/B Space Grade Silicone Rubber, Preparation and Application of	FS509330	
Scotch-Weld 2216 B/A Preparation, and Application of	FS502752	
Syringe Technique for Adhesive Bonding	FS502751	

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Table 4-2. COATING METALLIC

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Aluminum Vapor Deposition Process	FS513642	A low emissivity coating to be applied on the front surface of metallic optical elements
Aluminum Vapor Deposition Process for Corrosion Protection	MIL-C-23217	Class 1-0.0254 mm (0.0010") Thick; Class 2-0.127 mm (0.0005") Thick
Gold Coating, Vacuum Deposited on Metallic Substrates	FS512793	Will produce a low emissivity coating
Gold Plating, Electrodeposited	MIL-G-45204	For application to metallic surfaces. Type, grade and class shall be specified. Either bright or matte finish is acceptable unless otherwise specified. Preplating operations shall be accomplished before plating.
Ion Vapor Deposition Aluminum on Metals	MIL-C-83488	To coat low alloy steel, stainless steel, aluminum alloy and titanium alloy parts with high purity (99 percent plus)
Vacuum Deposited Aluminum or Gold Coating Over a Resin Undercoat on Nonmetallic Substrates	FS502766	Will produce a low emissivity coating

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Table 4-3. COATING NONMETALLIC

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Conformal Coating of Printed Wiring Boards, Zicon Spray Process	FS513155	For conformal coating of printed wiring boards and electronic assemblies in the static-sensitive level 2 class as defined in JPL D-8208
Dielectric Material, Application to Solar Panels	FS501410	
Iron Titanate, Plasma Spraying of	FS513172	On titanium and aluminum surfaces
Low Emittance Coating for High Visible Transmittance	FS502757	
MH-11, MH-11Z Thermal Control Paint, Application of	FS513200	High temperature, electrically conductive, thermal control paints for titanium and aluminum
Microcircuit Leads Re-forming for Toe-down or Toe-up	FS514858	
Nonmagnetic Electrically Conductive Black Thermal Control Paint	FS513331	Applied on epoxy fiberglass laminate, titanium, and aluminum surfaces. This paint was applied on fiberglass laminate on Galileo boom having a magnetic susceptibility of ≤ 0.05 nT, tested per TP512285.
NS43G White Inorganic Thermal and ESD Control Paint	FS516163	A white inorganic thermal and ESD control paint consisting of zinc oxide and potassium silicate
Temperature Control Paints, Application of	FS501424	Covers both electrically conductive and nonconductive temp. control paints
Zinc Orthotitanate (ZOT) Thermal Control Paint, Application of	FS511315	

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Table 4-3. COATING NONMETALLIC

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Conformal Coating of Printed Wiring Boards, Zicon Spray Process	FS513155	For conformal coating of printed wiring boards and electronic assemblies in the static-sensitive level 2 class as defined in JPL D-8208
Dielectric Material, Application to Solar Panels	FS501410	
Iron Titanate, Plasma Spraying of	FS513172	On titanium and aluminum surfaces
Low Emittance Coating for High Visible Transmittance	FS502757	
MH-11, MH-11Z Thermal Control Paint, Application of	FS513200	High temperature, electrically conductive, thermal control paints for titanium and aluminum
Microcircuit Leads Re-forming for Toe-down or Toe-up	FS514858	
Nonmagnetic Electrically Conductive Black Thermal Control Paint	FS513331	Applied on epoxy fiberglass laminate, titanium, and aluminum surfaces. This paint was applied on fiberglass laminate on Galileo boom having a magnetic susceptibility of ≤ 0.05 nT, tested per TP512285.
NS43G White Inorganic Thermal and ESD Control Paint	FS516163	A white inorganic thermal and ESD control paint consisting of zinc oxide and potassium silicate
Temperature Control Paints, Application of	FS501424	Covers both electrically conductive and nonconductive temp. control paints
Zinc Orthotitanate (ZOT) Thermal Control Paint, Application of	FS511315	

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Table 4-5. HEAT TREATMENT

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Case Hardening of Steel, Heat Treatment of	FS502750	Also covers the requirements for heat treatment prior to and after case hardening
Heat Treatment of Aluminum and Aluminum Alloys	AMS 2770	Parts made from wrought aluminum alloys shall be heat treated per AMS 2770.
Heat Treatment of Aluminum Alloys	ASTM B597	
Heat Treatment of Aluminum and Aluminum Alloys	MIL-H-6088	This spec covers mill products, castings (foundry) and raw forgings (forge-shops). Parts made from wrought aluminum alloys shall be heat treated per AMS 2770
Heat Treatment of Steels (Aerospace Practice, Process for)	MIL-H-6875	
Heat Treatment of Titanium and Titanium Alloys	MIL-H-81200	Covers copper alloys number 170, 172 and 175
Heat Treatment of Wrought Beryllium Copper Alloys, Process for	MIL-H-7199	
Pressure Vessels, Heat Treated Titanium Alloy (Ti-6Al-4V STA) Flight Equipment	FS509333	Updated 7/30/92
Stress Relief Cycling Criteria of Common Structural Metals, Detail Specification for	FS506025	

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Table 4-6. IC MODULE PROCESSES

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Electronic Part Installation, Integrated Circuit Module	D-8208 FP513414	
Equipment Identification (Electronic)	D-8208, Section 3.15 FP513414	
Identification Requirements for Parts and Assemblies (Other than Electronic)	FS500451	
Integrated Circuit Module Conformal Coating	D-8208, Section 3.18 FP513414	
Integrated Circuit Module Fabrication	D-8208, Section 3.15 FP513414	
Magnet Wire, Routing and Soldering Integrated Circuits	D-8208, Section 3.18 FP513414	
Replacement of IC's in IC Module	D-8208, Section 3.16 FP513414	
Spacecraft Electrolytic Etching Process, Identification of Parts and Assemblies	FS509332	

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Table 4-7. INSPECTION AND TESTING

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Blind Press Nuts, Inspection and Installation	MCO-50038-PRS	
Dye Penetrant Inspection of Dimensionally Sensitive, Fracture Critical Flight Hardware	QAI-30-35-177	
Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation	ASTM E309	To inspect discontinuities in ferromagnetic pipe and tubing
Electromagnetic (Eddy-Current) Examination of Nickel and Nickel Alloy Tubular Products	ASTM E571	
Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys	ASTM E426	Also used on nickel alloy (similar alloys)
Electromagnetic (Eddy-Current) Testing of Seamless Copper and Copper-Alloy Tubes	ASTM E243	
Induction Braze Tube Joints, Tube Preparation and Radiographic Inspection	FS505080	
Inspection Process, Magnetic Particle	MIL-STD-1949	
Liquid Penetrant Inspection Method	ASTM E165	
Magnetic Particle Examination	ASTM E709	
Magnetic Particle Examination of Steel Forgings	ASTM A275	
Magnetic Particle Inspection	MIL-STD-1949	
Nondestructive Evaluation (NDE) of Composite Materials	FS515880	
Nondestruction Evaluation (NDE) of Composite Materials Using Radiography, Specification Requirements for	FS515882	
Nondestructive Evaluation (NDE) of Composite Materials Using Ultrasonics, Specification Requirements for	FS515881	
Nondestructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant Magnetic Particle, Radiographic and Ultrasonic)	MIL-STD-410	
Nondestructive Testing (Ultrasonic)	MIL-STD-271	
Penetrant Inspection	MIL-STD-6866	Supersedes MIL-I-6866
Penetrant Inspection and Acceptance Criteria	FS502759	
Penetrant Inspection Materials	MIL-I-25135	

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Table 4-7. INSPECTION AND TESTING (Cont'd)

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Qualification of Critical Fasteners	FS511316	Covers fracture critical and shear critical fasteners and the color identification scheme
Radiographic Inspection	MIL-STD-453	
Radiographic Inspection, Soundness Requirements for Arc and Gas Welds in Steel	MIL-STD-1264	
Radiographic Inspection and Standards for Aluminum Weldments	MIL-R-45774	
Rivets and Screw Joints, Inspection and Installation	FS505920	
Ultrasonic Inspection Requirements	MIL-STD-1875	
Ultrasonic Inspection of Wrought Metals	MIL-STD-2154	Supersedes MIL-I-8950
Welded Joints, Inspection of	MIL-STD-1890	
Workmanship Standards for Mechanical Parts and Materials	FS504040	

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Table 4-8. INSTALLATION

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Blind Press Nuts, Inspection and Installation	MCO-50038-PRS	
Bonding of Printed Wiring Terminal and Insulation Boards with Eccobond 55/9	D-8208, Section 3.6 FP513414	
Connector Installation - Rectangular Miniature	D-8208, Section 3.12 FP513414	
Fabrication and Use of Lacing Ties	D-8208, Section 3.12 FP513414	
Installation of Bearings, Self-aligning, Plain, and Bushings, Sintered	FS503905	
Installation, Fasteners, Blind Nut	FS503904	
Installation of Key Locked Threaded Inserts	FS505925	
Installation, Rivet, Self-Plugging, Blind	FS503918	
Installation of Temperature Transducers	D-8208, Section 3.4 FP513414	
Modification and Rework of Planar Electronic Subassemblies	D-8208, Section 3.16 FP513414	
Non-Impact Installation of Thinwall Threaded Inserts	— *	
Process Specification, Impact Installation of Thinwall Inserts	D-8208, Section 3.3 FP513414	
Process Specification, Installation and Inspection of Solid Rivets and Screws	FS505920	

*Specification could not be found.

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Table 4-9. LOCKING FASTENERS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Solithane 113 Catalyst C113-300 Thermolite 12	BS502695 (Resin and Catalyst) BS506313 (Catalyst) BS502698 (Accelerator) D-8208, Section 3.18 FP513414	To avoid use of thread- locking inserts or helicals. For details see specifications.
Stycast 2850 FT/11	BS513151 D-8208, Section 3.18 FP513414	For spot bonding heads and fasteners. For details see specification.

SECTION 4.0 - PROCESSES

Table 4-10. LUBRICATION

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Application of Solid Film Lubricants	FS502753	To produce a thin, dry, permanently bonded layer of lubricative material on threaded fasteners to reduce wear and to provide an antiseize quality on bearing surfaces
Application of Solid Film Lubricants on Corrosion Resistant Fasteners	FS516025	Specific procedure for cleaning and lubricating corrosion resistant fasteners
Lubricant, Bonded, Solid, Burnishing of	FS504447	For the burnishing of solid bonded lubricant prior to final assembly of bearing surfaces

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SECTION 4.0 - PROCESSES

Table 4-11. MECHANICAL PROCESSES

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Buffing Metal Surfaces	FS509339	To produce smooth, highly reflective (mirror-like), scratch-free surfaces
Electrical Discharge Machining	FS509335	
Installation of Key Locked Threaded Inserts	FS505925	
Installation of Thinwall Threaded Inserts, Impact	FS504270	
Installation of Thinwall Threaded Inserts, Non-Impact	GMO-20514-PRS	
Rivet and Screw Hole Preparation	FS505920	
Shot Peening of Metal Parts	MIL-S-13165	Intended to reduce surface tensile stress in metal parts
Torque Requirements, Threaded Fasteners, Spacecraft Structural and Electronic Equipment	ES504255	
Tubing End, Standard Dimensions for Flared	MS33584	
Workmanship Standards for Mechanical Parts and Materials	FS504040	Updated 7/13/92

SECTION 4.0 - PROCESSES

Table 4-12. PLATING AND SOLDER COATINGS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Black Chromium	MIL-C-14538	Has limited corrosion protection. Nickel underplate can provide added protection. Usually applies to steel but can be used on brass, copper, iron and Cr
Black Coating for Copper	MIL-F-495	A uniform black corrosion retardant
Black Oxide Coating	MIL-C-13924	A uniform coating but provides limited corrosion protection
Chromium Plating, Electrodeposited	QQ-C-320	Has excellent wear and erosion resistance
Coating, Hard Chromium Alloy, Application of (Electrodeposited)	FS502755	Should not be used on Mg, Ti, Pb, and their alloys. Cannot obtain surface finish better than 32 rms for aluminum alloys
Coating, Nickel-Phosphorus Electroless Nickel, Requirements	MIL-C-26074	Good corrosion resistance if over 0.0254 mm (0.001") thick. Provides uniform coating. Does not build on edges
Copper Plating, Electrodeposited	MIL-C-14550	Can be used for heat treat stop-off. Undercoating for nickel plating
Gold Plating, Electrodeposited	MIL-G-45204	Good corrosion resistance. Provides low contact resistance and excellent solderability. A good conductor
Gold Plating, Electrodeposited for Magnesium Alloys	FS501437	To obtain a surface with low absorptance or emittance for temp. control
Gold Plating for Aluminum and Aluminum Alloys	MIL-G-45204 (Zincate per ASTM B253 as underplate)	This is general gold plating process Spec. It has 3 types, 4 grades and 8 classes specifying the purity of gold, hardness and thickness of plating
Gold Plating for Titanium and Titanium Alloys	MIL-G-45204 (Prepare for Plating per ASTM B481)	

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Table 4-12. PLATING AND SOLDER COATINGS (Cont'd)

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Immersion Gold Coating (Electroless Gold)	FS502765	Will produce a thickness of 0.508 to 1.02 mm (0.020 to 0.040 inch) of gold on a base metal or underplating of copper only
Nickel Plating, Electrodeposited	QQ-N-290	For corrosion protection. Consult Materials Technology Group if steel to be plated, has tensile strength above 1520 MPa (220 ksi)
Plating Aluminum for Solderability (Zinc Immersion Process)	AMS 2420	
Plating, Black Nickel (Electrodeposited) on Brass, Bronze or Steel	MIL-P-18317	
Plating Gold for Thermal Control	AMS 2425	
Preparation of Aluminum and Aluminum Alloys for Electroplating	ASTM B253	Covers zinc immersion with copper and nickel strikes
Selective Plating (Brush) Electrodeposition Anodizing Aluminum Hard Facing Chromium Copper Gold Lead Nickel Palladium Rhodium Silver Tin Tin-Lead	MIL-STD-865 MIL-STD-2197 MIL-A-8625, Type I and II MIL-P-47184 QQ-C-320 MIL-CL-14550 MIL-G-45204 MIL-L-13808 QQ-N-290 MIL-P-45209 MIL-R-46085 QQ-S-365 MIL-T-10727, Type I MIL-P-81728	Can be used to plate on the following alloys: aluminum, copper, nickel and corrosion resistant steel. (Refer to code BTE Appendix A)
Silver Plating, Electrodeposited	QQ-S-365	Excellent solderability. Excellent electric conductor
Solder Plating	D-8208, Section 3.6 FP513414	

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Table 4-13. POTTING, ENCAPSULATING AND EMBEDMENT

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Application of Solithane 113/C113-300 Conformal Coating (Fluorescent and Nonfluorescent)	D-8208, Section 3.18 FP513414	
Bonding Inserts into Honeycomb Sandwich	FS509338	
Coating of Electrical Conductors Exposed to Ultraviolet Radiation	D-8208, Section 3.18 FP513414	
Conformal Encapsulation of Electrical Conductors	D-8208, Section 3.18 FP513414	
Embedment of Electronic Modules in an Opaque, Lightweight Epoxy	D-8208, Section 3.18 FP513414	
Embedment and Reinforcement with Epoxy Resin (Stycast 1090/24 LV)	FS513311	
Filling Edges of Honeycomb Sandwich	FS509337	Can also be used for embedment and reinforcement of honeycomb structures.
Impregnation and Embedment of Transformers (One Step Process)	D-8208, Section 3.13 FP513414	
Impregnation and Embedment of Transformers and Inductors (Two Step Process)	D-8208, Section 3.13 FP513414	
Insulation and Sealing of Rectangular Miniature and Circular Miniature Quick- Disconnect Connectors	D-8208, Section 3.12 FP513414	
Potting Circular Connectors	D-8208, Section 3.12 FP513414	
Potting of Subminiature, Rectangular Connectors	D-8208, Section 3.12 FP513414	
Structural Embedment and Reinforcement with Stycast 1090/11	D-8208, Section 3.18 FS502767, FS513414	

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Table 4-14. SPOT BONDING

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Spot Bonding of Component Parts With Eccobond 104	D-8208, Section 3.18 FP513414	For wire bundles and fasteners
Spot Bonding of Component Parts With Scotch Weld 2216 B/A With Filler	BS515871	Semi-rigid spot bonding material for electronic parts and wire bundles (Replaces 1095/9)
Spot Bonding Electronic Parts With Solithane 113/C113-300 Filled Polyurethane	D-8208, Section 3.18 FP513414	

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Table 4-15. SURFACE TREATMENT, GENERAL

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Cleaning of Nonmetallic Materials	D-8208, Section 3.17 FP513414	
General Cleaning of Materials	FS505146	This specification includes passivation treatments of metals such as stainless steels, nickel alloys and titanium alloys
Preparation and Application of Phosphate Coating Paint Base for Ferrous and Nonferrous Alloys	FS502704	Will remove rust from the parts and produce a slight etching action
Preparation of Surfaces for Adhesive Bonding	FS504508	
Protective Finishes for Space Vehicle Structures and Associated Flight Equipment	MSFC-SPEC-250A	
Surface Treatments and Inorganic Coatings for Metal Surfaces of Weapons Systems	MIL-S-5002	Covers cleaning, surface treatments and inorganic coatings for metallic surfaces

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Table 4-16. SURFACE TREATMENT, FERROUS ALLOYS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Case Hardening of Steel	FS502750	
Coating, Black Oxide, for Ferrous Metals	MIL-C-13924	The black coating for decorative purposes only; it offers very little corrosion protection
General Cleaning of Materials	FS505146	Includes passivation treatment of steels
Phosphate Coating	DOD-P-16232	A coating for medium and low alloy steels. It provides moderate corrosion resistance and prevents wear
Preparation and Application of Phosphate Coating Paint Base for Ferrous and Nonferrous Alloys	FS502704	

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Table 4-17. SURFACE TREATMENT, COPPER ALLOYS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Finish, Chemical Black, for Copper Alloys	MIL-F-495	No dimensional change

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Table 4-18. SURFACE TREATMENT, ALUMINUM ALLOYS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Anodic Coatings for Aluminum and Aluminum Alloys	MIL-A-8625 Type I Type II Type III Class 1 Class 2	Chromic acid anodize Sulfuric acid anodize Hard coating Non-dyed Dyed
Chemical Conversion Coatings on Aluminum and Aluminum Alloys	MIL-C-5541 Class 1A Class 3	For maximum protection against corrosion For corrosion protection where low electrical resistance is required
Coating of Aluminum Alloys, Anodic, Black	FS502703	Used for thermal control. Will produce surface with high thermal emittance and low solar reflectance
Hard Anodizing, Aluminum Alloys	AMS 2468	Used for electrical and wear resistance

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Table 4-19. SURFACE TREATMENT, MAGNESIUM ALLOYS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Anodic Treatment of Magnesium Alloys (Dow 17)	FS507016, MIL-M-45202	Coating ranges from thin clear to light grey-green to thick dark green. The thick dark green coating offers the best corrosion, abrasion resistance and as a paint base
Conversion Coating of Magnesium Alloys (Dow 7)	FS502754 MIL-M-3171, Type III	Has only fair corrosion resistance
Conversion Coating of Magnesium Alloys (Dow 19)	FS502705, MIL-M-3171, Type VI	For touchup
Conversion Coating of Magnesium Alloys (Dow 19 for Processing and Touching up of Corroded Parts)	FS505144, MIL-M-3171, Type VI	
Galvanic Anodize (Dow 9)	MIL-M-3171, Type IV	A dark brown to black coating. It is primarily used for optical instruments. Has only fair corrosion resistance
Stannate Immersion Coating (Dow 23)	Dow Chemical Process	An electrically conductive coating; no specification available

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Table 4-20. SURFACE TREATMENT, TITANIUM ALLOYS

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Anodic Treatment of Titanium and Titanium Alloys	AMS 2488	Type 1 - For elevated temperature forming Type 2 - An anti-galling coating. Can be used as pretreatment for dry film lubricants. Electrically semi-conductive
General Cleaning of Material	FS505146	Covers passivation of titanium alloys

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Table 4-21. VACUUM OUTGASSING

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
General Specification, Vacuum Stability Requirements of Polymeric Materials for Spacecraft Application	SP-R-0022A	
Standard Test Method for Total Mass Loss and Collected Volatile Condensible Materials from Outgassing in a Vacuum Environment	ASTM E595	
Vacuum Outgassing of Polymers (Micro-VCM), Detail Specification	TS507035	

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Table 4-22. WELDING, BRAZING, AND SOLDERING

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Aerospace Welder Performance Qualification	MIL-STD-1595	MIL-T-5021, "Tests; Aircraft and Missile Welding Operators Qualification" has been canceled and was incorporated into this specification
Brazing Aluminum and Aluminum Alloys	GMO-50284-PRS	
Brazing of Steels, Copper, Copper Alloys, Nickel Alloys, Aluminum and Aluminum Alloys	MIL-B-7883	It covers torch brazing, furnace brazing, resistance brazing, induction brazing, and dip brazing
Electron Beam Welding	MIL-STD-2103	
Fusion Welding for Aerospace Applications	MIL-STD-2219	Provides minimum requirements for weld filler materials, workmanship, inspection and record requirements for fusion welding of alloys. Applicable to aircraft, missiles, and also to aerospace structures
Induction Braze Tube Joints, Tube Preparation and Radiographic Inspection	FS505080	
Soldering of Gold Plated Flexible and Rigid Waveguides	FS507292	For soldering a flexible gold plated BeCu waveguide to a rigid gold plated aluminum (6061) waveguide
Soldering Process, General Specification	DOD-STD-1866	
Welding and Brazing Procedure and Performance Qualification	MIL-STD-248	
Welding, Electron Beam, Detail Specification for	FS502760	
Welding, Resistance, Aluminum, Magnesium, Nonhardening Steel or Alloys, Nickel Alloys, Heat Resistant Alloys and Titanium Alloy, Spot and Seam	MIL-W-6858	Group 1 - Aluminum and Magnesium Group 2 - Iron, Nickel and Cobalt Group 3 - Titanium

JPL-STD00009 Rev. B**SECTION 4.0 - PROCESSES****Table 4-23. MISCELLANEOUS**

TITLE	PROCESS SPECIFICATION OR DOCUMENT	COMMENTS
Application of CPR 385 Spray Foam to Laminated Substrate	FS502768	
Application of Silicone Thermal Grease (G-683)	FS505069	
Clean Room and Works Station Requirements	FED-STD-209	
Desiccants, Activated, Bagged, Packaging Use, and Static Dehumidification	MIL-D-3464	
Electrical Conductivity Test for Measurement of Heat Treatment of Aluminum Alloys, Eddy Current Method	MIL-STD-1537	Determines its conductivity in ohm centimeters or in percent of the International Annealed Copper Standard (IACS) by comparison with certified conductivity standards
Epoxy Resin, Glass Fabric Laminate, Vacuum Bag Molding	FS502758	
Fabrication of Structural Polyester Resin/Glass Fabric Laminates	FS502764	
Indicator, Humidity, Card, Three Spot, Impregnated Areas (Cobaltous Chloride)	MS-200003	
Silver Filled Polyurethane Resin (Solithane 113/C113-300 Silver Flake)	FS502769	
Tanks, Propellant, Titanium Alloys (Ti-6 Al-4V), Viking Orbiter Flight Equipment	FS505282	
Workmanship Standards for Mechanical Parts and Materials	FS504040	
Qualification of Critical Fasteners	FS511316	
Vapor Degreaser Operation, Detail Specification for	FS515508	Special handling and precautions and use of solvents

INTRODUCTION

This section (5.0 of JPL Engineering Standard JPL STD00009) is intended to supply the technical staff of JPL with information on commonly used flight threaded fasteners.

The flight fasteners are the subject of JPL Standard Practice Instruction (SPI) 4-11-8* * entitled "Fasteners for Flight Applications." This SPI carries requirements for (1) certification of fasteners, (2) selection of fasteners for flight application from the Flight [Fasteners List JPL STD00009 Section 5, (3) special considerations pertaining to flight structural fasteners (#8-32 and larger), and (4) fastener documentation on JPL drawings.

High reliability A286 material fasteners of 1,310 MPa (190 KSI) ultimate tensile strength do not carry restriction notes. Fasteners suitable for use in less stringent applications will have a note on the individual pages in JPL STD00009 Section 5 stating:

"The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications."

* To be supplied at a later date

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 5.0 - Fasteners

(This section does not include metric dimensional callouts for fasteners, packaging and cabling hardware. These will be included in a future amendment.)

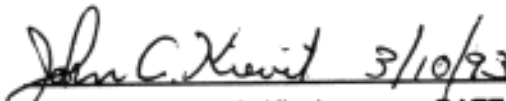
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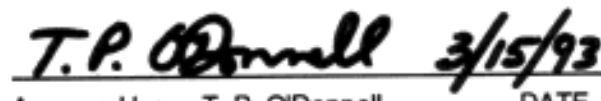


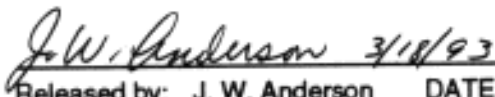
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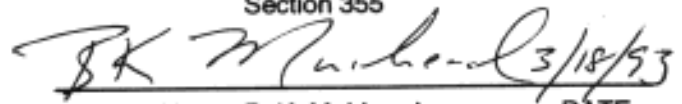
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Section 5.0 - Fasteners

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Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 5. 1 - Preferred Fastener List

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Section 5.1.1 - Fastener Alphabetical Listing

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Jet Propulsion Laboratory
California Institute of Technology

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Blind Nut Assembly, Blind Expander, Nonlocking, Cres	BB414-(632,832, 1032,12)	HSH-73197	DWG NO BN537
Blind Nut Assembly, Expander, Locking And Nonlocking	BN330-(1032,428) -(1 Thru 26)	HSH-73197	DWG NO BN525
Blind Nut Assembly, Expander, Locking And Nonlocking	BN330-(440,632,) -(1 Thru 12)	HSH-73197	DWG NO BN525
Blind Nut Assembly, Expander, Locking And Nonlocking	BN330-832 -(1 Thru 17)	HSH-73197	DWG NO BN525
Blind Nut Assembly, Expander, Nonlocking, Cres	BB415(NL)-(5,632, 1032,8,12)	HSH-73197	DWG NO BN525
Blind Nut,Rivnut Countersunk Head, Closed End, Keyed, Aluminum Alloy	ST10225-(1,2,3,8,9, 14,15,21,22)	GOE-03481	ST10225
Blind Nut,Rivnut Flat Head, Closed End, Keyed, Aluminum Alloy	ST10224-(1,2,3,8,9, 14,15,21,22)	GOE-03481	ST10224
Blind Nut,Rivnut Flat Head, Open End, Keyed, Aluminum	ST11294-(1,2,3,8,9, 14,15,21,22)	GOE-03481	ST11294
Bolt, 100 Deg. Flush Head	NAS1580C3H (3 Thru 20)	Open Bid May Incl BURBANK AIR H.C. PACIFIC	NAS1580
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-06 -(1 Thru 12) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136

* Commercial and Government Entity

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-08 -(1 Thru 16) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-10 -(1 Thru 24) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-25 -(1 Thru 24) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-31 -(1 Thru 32) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	DS136-50 -(1 Thru 32) (Blank,L)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
Insert, Blind, Molded In, Cres	SL6061C (02,04,06,08,3)	SHL-97393 RXN-29372	DWG SL6061
Insert, Nonlocking, Heavy Duty, Blind	KNHB(0832,1032,428,524,624,820)J	RXN-29372	REXNORD DWG KNHB()J
Insert, Nonlocking, Light Weight, Blind, 303	KNB(1032,428,524,624,820)J	RXN-29372	REXNORD DWG KNB()J
Insert, Nonlocking, Miniature, Blind, 303	KNCB(0256,0440,0632,0832)J	RXN-29372	REXNORD DWG KNCB()J

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Insert, Threaded Metal, Heavy Duty, Non Self-Locking	NAS1395C(04, 06,08,3 Thru 8)	RXN-29372 KNR-15653	NAS1395
Insert, Threaded Metal, Light Weight, Non Self-Locking	NAS1394C(08, 3 Thru 8)	RXN-29372 KNR-15653	NAS1394
Insert, Threaded, Molded In, Cres	SL6096C (04,06,08,3)-250	SHL-97393 RXN-29372	DWG SL6096
Insert, Thru Hole, Molded In, Aluminum	SL6089 (04,06,08,3)-250	SHL-97393 RXN-29372	DWG SL6089
Nut, Captive Washer, Self-Locking, Cres	ST10049-(1 thru 4,6,8)	KNR-15653	ST10049
Nut, Hexagon, Self-Locking, Cres, Drylubed	ST10061-(1 thru 8)	SPS-56878	ST10060
Nut, Hexagon, Self-Locking, Cres, Silver Plated	ST10060-(1 thru 8)	SPS-56878	ST10060
Nut, Plain, Hexagon, Machine Screw, UNC-2B, Cres	MS35649-(224, 244,264,284)	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35649
Nut, Plain, Hexagon, Machine Screw, UNF-2B, Cres	MS35691-(15,23,31, 39,47,55,63)	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35691
Nut, Plain, Hexagon, Machine Screw, UNF-2B, Cres	MS35650 -(304,3254)	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35650

* Commercial and Government Entity

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Nut, Self-Locking, Plate, 2 Lug, Floating, Reduced Rivet Spacing	MS21076L(04,06,08,3,4,5)N	Open Bid May Incl KNR-15653 BURBANK AIR H.C. PACIFIC	MS21076
Nut, Self-Locking, Plate, 2 Lug, Floating, Reduced Rivet Spacing	MS21076-(04,06)N	Open Bid May Incl KNR-15653 BURBANK AIR H.C. PACIFIC	MS21076
Pins, Straight, Headless, (Dowel), 410 or 416 Cres	MS16555-(601 Thru 608, 617 Thru 624, 625 Thru 633, 640 Thru 667)	Open Bid May Incl SPS-15653 BURBANK AIR H.C. PACIFIC	MS16555
Ring, Retaining, External, Basic (Tapered Section Type) Cres Ph15-7Mo	MS16624-(4025,4031,4037,4043,4050,4056,4062,4068,4075)	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16624
Ring, Retaining, External, "E" (Reduced Section Type) Cres Ph15-7Mo	MS16633-(4006,4009,4012,4015,4018,4025)	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16633
Ring, Retaining, Internal, Basic (Tapered Section Type) Cres Ph15-7Mo	MS16625-(4050,4056,4062,4068,4075,4081,4087,4093,4100)	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16624
Rivet, Blind, Csk Head, Aluminum	CR3222DL4 -(05,06)	CRD-11815	DWG NO CR3222DL
Rivet, Blind, Csk Head, Aluminum	CR3222DL5 -(05 Thru 08)	CRD-11815	DWG NO CR3222DL
Rivet, Blind, Csk Head, Aluminum	CR3222DL6 -(06 Thru 12)	CRD-11815	DWG NO CR3222DL

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Rivet, Blind, Csk Head, Bulb Type, Aluminum	CR3252DL4 -(02 Thru 04)	CRD-11815	DWG NO CR3252DL
Rivet, Blind, Csk Head, Bulb Type, Aluminum	CR3252DL5 -(02 Thru 04)	CRD-11815	DWG NO CR3252DL
Rivet, Blind, Csk Head, Bulb Type, Aluminum	CR3252DL6 -(02 Thru 05)	CRD-11815	DWG NO CR3252DL
Rivet, Blind, Csk Head, Bulb Type, Monel	CR3552DL4 -(02 Thru 04)	CRD-11815	DWG NO CR3552DL
Rivet, Blind, Csk Head, Bulb Type, Monel	CR3552DL5 -(02 Thru 04)	CRD-11815	DWG NO CR3552DL
Rivet, Blind, Csk Head, Bulb Type, Monel	CR3552DL6 -(02 Thru 05)	CRD-11815	DWG NO CR3552DL
Rivet, Blind, Csk Head, Monel	CR3522DL4 -(05,06)	CRD-11815	DWG NO CR3522DL
Rivet, Blind, Csk Head, Monel	CR3522DL5 -(05 Thru 08)	CRD-11815	DWG NO CR3522DL
Rivet, Blind, Csk Head, Monel	CR3522DL6 -(06 Thru 12)	CRD-11815	DWG NO CR3522DL
Rivet, Blind, Universal Head, Aluminum	CR3223DL5 -(05 Thru 08)	CRD-11815	DWG NO CR3223DL
Rivet, Blind, Universal Head, Aluminum	CR3223DL4 -(05,06)	CRD-11815	DWG NO CR3223DL
Rivet, Blind, Universal Head, Aluminum	CR3223DL6 -(06 Thru 12)	CRD-11815	DWG NO CR3223DL

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Rivet, Blind, Universal Head, Bulb Type, Aluminum	CR3253DL4 -(01 Thru 04)	CRD-11815	DWG NO CR3253DL
Rivet, Blind, Universal Head, Bulb Type, Aluminum	CR3253DL5 -(01 Thru 04)	CRD-11815	DWG NO CR3253DL
Rivet, Blind, Universal Head, Bulb Type, Aluminum	CR3253DL6 -(01 Thru 05)	CRD-11815	DWG NO CR3253DL
Rivet, Blind, Universal Head, Bulb Type, Monel	CR3553DL4 -(01 Thru 04)	CRD-11815	DWG NO CR3553DL
Rivet, Blind, Universal Head, Bulb Type, Monel	CR3553DL5 -(01 Thru 04)	CRD-11815	DWG NO CR3553DL
Rivet, Blind, Universal Head, Bulb Type, Monel	CR3553DL6 -(01 Thru 05)	CRD-11815	DWG NO CR3553DL
Rivet, Blind, Universal Head, Monel	CR3523DL4 -(05 Thru 06)	CRD-11815	DWG NO CR3523DL
Rivet, Blind, Universal Head, Monel	CR3523DL5 -(05 Thru 08)	CRD-11815	DWG NO CR3523DL
Rivet, Blind, Universal Head, Monel	CR3523DL6 -(06 Thru 12)	CRD-11815	DWG NO CR3523DL
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-00 -(2 Thru 6)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-00 -(4 Thru 6)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-02 -(3 Thru 6)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-02 -(4 Thru 6)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-04 -(4 Thru 8)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-04 -(4 Thru 8)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-06 -(4 Thru 12)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-06 -(5 Thru 12)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-08 -(5 Thru 16)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-08 -(6 Thru 16)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-10 -(5 Thru 24)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-10 -(8 Thru 24)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-25 -(6 Thru 32)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	DS134-25 -(8 Thru 32)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-02 -(2 Thru 6)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-02 -(3 Thru 6)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-04 (1 Thru 8)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-04 (1 Thru 8)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-06 (1 Thru 12)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-06 (1 Thru 12)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-08 (1 Thru 16)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-08 (1 Thru 16)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-10 (1 Thru 24)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-10 (1 Thru 24)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-1/4 (2 Thru 24)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-1/4 (2 Thru 24)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-5/16 (2 Thru 28)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-5/16 (2 Thru 28)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-3/8 (3 Thru 32)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-3/8 (3 Thru 32)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-1/2 (4 Thru 32)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	DS83-1/2 (4 Thru 32)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
Screw Mach, Flat, Count, Head, 100 Deg Cross-Recessed, Cres	MS24693C(1 Thru 6, 23 Thru 30, 46 Thru 54, 268 Thru 280)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	MS24693
Screw, Machine, Pan Head, Cross-Recessed, Cres, UNC-2A	MS51957-(1 Thru 7, 11 Thru 17, 25 Thru 32, 42 Thru 49)	Open Bid May Incl BURBANK AIR H.C. PACIFIC	MS51957
Screw, Machine, Pan Head, Cross-Recessed, Cres, UNC-2A	MS51958-(59 Thru 69, 76 Thru 87)	Open Bid May Incl BURBANK AIR H.C. PACIFIC	MS51958
Screw, Pan Head, Cross Recessed, Locking, Cres	ST10072-(3 Thru 7, 14 Thru 17, 28 Thru 32, 44 Thru 49, 62 Thru 69, 79 Thru 87)	LLC-03038	ST10072
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-00 -(2 Thru 4)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-00 -(3,4)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-04 -(4 Thru 8)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-04 -(3 Thru 8)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-06 -(3 Thru 12)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-08 -(3 Thru 16)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-08 -(4 Thru 16)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-10 -(3 Thru 24)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-25 -(4 Thru 32)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-02 -(2 Thru 6)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-02 -(2 Thru 6)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-06 -(4 Thru 12)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-10 -(6 Thru 24)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, (A286)	DS132-25 -(6 Thru 32)L	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
Screw, Pan Head, Hi-Torque Recess, Locking, A-286	ST10073-(4 Thru 7, 16 Thru 19, 29 Thru 33, 45 Thru 49 65 Thru 70, 80 Thru 88, 95 Thru 104)	LLC-03038	ST10073

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Screw, Socket Head, Hexagon, Locking, Cres	ST10051-(1 Thru 4, 9 Thru 13, 16 Thru 20, 25 Thru 29, 40 Thru 44, 50 Thru 53, 70 Thru 72, 81 Thru 84))	LLC-03038	ST10051
Setscrew, Hex Socket, Headless, Cres	AN565DC2H (3,4,5)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
Setscrew, Hex Socket, Headless, Cres	AN565DC4H (3 Thru 10)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
Setscrew, Hex Socket, Headless, Cres	AN565DC6H (4 Thru 10)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
Setscrew, Hex Socket, Headless, Cres	AN565DC8H (4 Thru 12)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
Setscrew, Hex Socket, Headless, Cres	AN565DC1032H (4 Thru 12)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
Setscrew, Hex Socket, Headless, Cup Point, Cres	AN565DC428 (5 Thru 14)	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565

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Description	Controlling Part Number	Approved Suppliers Code and CAGE* Number	Controlling Documents
Washer, Countersunk, Cres	90273-(4 thru 10, 23,26,27,30)F	Open Bid May Incl CAL SWISS	DWG 90273
Washer, Countersunk, Aluminum	90273-(4 thru 9, 28)C	Open Bid May Incl CAL SWISS	DWG 90273
Washer, Flat	AN960C(4,6,8,416, 516,616,716) (Blank,L)	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	DWG NO AN960
Washer, Flat, Metal, Round, General Purpose, Aluminum	MS15795-(701 Thru 717,741,742)	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	MS15795
Washer, Flat, Metal, Round, General Purpose, Cres	MS15795-(801 Thru 803, 805 Thru 817, 842,844,852)	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	MS15795
Washer, Flat, Reduced Outside Diameter, Aluminum	NAS620A (4,6,8,10,416) (Blank,L)	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	NAS620
Washer, Flat, Reduced Outside Diameter, Cres	NAS620C (4,6,8,10,416) (Blank,L)	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	NAS620

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 5. 1 .2 - Fastener Numerical Listing

April 1993



Jet Propulsion Laboratory
California Institute of Technology

JPL D-9984

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS83-02 -(2 Thru 6)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-02 -(3 Thru 6)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-04 (1 Thru 8)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-04 (1 Thru 8)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-06 (1 Thru 12)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-06 (1 Thru 12)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-08 (1 Thru 16)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS83-08 (1 Thru 16)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-10 (1 Thru 24)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-10 (1 Thru 24)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-1/4 (2 Thru 24)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-1/4 (2 Thru 24)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-5/16 (2 Thru 28)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-5/16 (2 Thru 28)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS83-3/8 (3 Thru 32)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-3/8 (3 Thru 32)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-1/2 (4 Thru 32)	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS83-1/2 (4 Thru 32)L	Screw, Internal Wrenching, Cres, Self-Locking and Non-Self Locking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS83
DS132-00 -(2 Thru 4)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-00 -(3,4)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-02 -(2 Thru 6)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS132-02 -(3 Thru 6)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-04 -(3 Thru 8)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-04 -(4 Thru 8)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-06 -(3 Thru 12)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-06 -(4 Thru 12)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-08 -(3 Thru 16)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-08 -(4 Thru 16)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132

** Commercial and Government Entity

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Section 5.1.2
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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS132-10 -(3 Thru 24)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-10 -(6 Thru 24)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-25 -(4 Thru 32)	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS132-25 -(6 Thru 32)L	Screw, Pan Head, Hi-Torque Recess, (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS132
DS134-00 -(2 Thru 6)	Screw, Csk Hd, Hi- Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-00 -(4 Thru 6)L	Screw, Csk Hd, Hi- Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-02 -(3 Thru 6)	Screw, Csk Hd, Hi- Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134

** Commercial and Government Entity

JPL STD00009 Rev. B
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Numerical Listing*

* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS134-02 -(4 Thru 6)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-04 -(4 Thru 8)	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-04 -(4 Thru 8)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-06 -(4 Thru 12)	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-06 -(5 Thru 12)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-08 -(5 Thru 16)	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-08 -(6 Thru 16)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134

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JPL STD00009 Rev. B
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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS134-10 -(5 Thru 24)	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-10 -(8 Thru 24)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-25 -(6 Thru 32)	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS134-25 -(8 Thru 32)L	Screw, Csk Hd, Hi-Torque Recess (A286) Full Thread, Locking and Nonlocking	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG NO DS134
DS136-06 -(1 Thru 12) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
DS136-08 -(1 Thru 16) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
DS136-10 -(1 Thru 24) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
DS136-25 -(1 Thru 24) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
DS136-31 -(1 Thru 32) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
DS136-50 -(1 Thru 32) (Blank,L)	Bolt, Close Tolerance, 12 Point, External Wrenching, Locking And Nonlocking (A286)	AIR IND-06725 HSH-73197 SPS-56878 VOI-92215 SEE QSL	DWG DS136
BN330-(440,632,) -(1 Thru 12)	Blind Nut Assembly, Expander, Locking And Nonlocking	HSH-73197	DWG NO BN537
BN330-(832 -(1 Thru 17)	Blind Nut Assembly, Expander, Locking And Nonlocking	HSH-73197	DWG NO BN537
BN330-(1032,428) -(1 Thru 26)	Blind Nut Assembly, Expander, Locking And Nonlocking	HSH-73197	DWG NO BN537
BB414-(632,832, 1032,12)	Blind Nut Assembly, Blind Expander, Locking And Nonlocking, Cres	HSH-73197	DWG NO BN537
BB415(NL)-(5, 632,1032,8,12)	Blind Nut Assembly, Blind Expander, Nonlocking, Cres	HSH-73197	DWG NO BN537
AN565DC2H (3,4,5)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
AN565DC4H (3 Thru 10)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
AN565DC6H (4 Thru 10)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
AN565DC8H (4 Thru 12)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
AN565DC1032H (4 Thru 12)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
AN565DC428 (5 Thru 14)	Setscrew, Hex Socket, Headless, Cup Point, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	AN565
NAS620A (4,6,8,10,416) (Blank,L)	Washer, Flat, Reduced Outside Diameter, Aluminum	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	NAS620
NAS620C (4,6,8,10,416) (Blank,L)	Washer, Flat, Reduced Outside Diameter, Cres	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	NAS620

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
AN960C(4,6,8,416, 516,616,716) (Blank,L)	Washer, Flat	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	DWG NO AN960
NAS1394C(08, 3 Thru 8)	Insert, Threaded Metal, Light Weight, Self-Locking, Non Self-Locking	RXN-29372 KNR-15653	NAS1394
NAS1395C(04, 06,08,3 Thru 8)	Insert, Threaded Metal, Heavy Duty, Self-Locking, Non Self-Locking	RXN-29372 KNR-15653	NAS1395
NAS1580C3H (3 Thru 20)	Bolt, 100 Deg. Flush Head	Open Bid May Incl BURBANK AIR H.C. PACIFIC	NAS1580
CR3222DL4 -(05,06)	Rivet, Blind, Csk Head, Aluminum	CRD-11815	DWG NO CR3222DL
CR3222DL5 -(05 Thru 08)	Rivet, Blind, Csk Head, Aluminum	CRD-11815	DWG NO CR3222DL
CR3222DL6 -(06 Thru 12)	Rivet, Blind, Csk Head, Aluminum	CRD-11815	DWG NO CR3222DL
CR3223DL4 -(05,06)	Rivet, Blind, Universal Head, Aluminum	CRD-11815	DWG NO CR3223DL
CR3223DL5 -(05 Thru 08)	Rivet, Blind, Universal Head, Aluminum	CRD-11815	DWG NO CR3223DL
CR3223DL6 -(06 Thru 12)	Rivet, Blind, Universal Head, Aluminum	CRD-11815	DWG NO CR3223DL

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
CR3252DL4 -(02 Thru 04)	Rivet, Blind, Csk Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3252DL
CR3252DL5 -(02 Thru 04)	Rivet, Blind, Csk Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3252DL
CR3252DL6 -(02 Thru 05)	Rivet, Blind, Csk Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3252DL
CR3253DL4 -(01 Thru 04)	Rivet, Blind, Universal Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3253DL
CR3253DL5 -(01 Thru 04)	Rivet, Blind, Universal Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3253DL
CR3253DL6 -(01 Thru 05)	Rivet, Blind, Universal Head, Bulb Type, Aluminum	CRD-11815	DWG NO CR3253DL
CR3522DL4 -(05,06)	Rivet, Blind, Csk Head, Monel	CRD-11815	DWG NO CR3522DL
CR3522DL5 -(05 Thru 08)	Rivet, Blind, Csk Head, Monel	CRD-11815	DWG NO CR3522DL
CR3522DL6 -(06 Thru 12)	Rivet, Blind, Csk Head, Monel	CRD-11815	DWG NO CR3522DL
CR3523DL4 -(05 Thru 06)	Rivet, Blind, Universal Head, Monel	CRD-11815	DWG NO CR3523DL
CR3523DL5 -(05 Thru 08)	Rivet, Blind, Universal Head, Monel	CRD-11815	DWG NO CR3523DL
CR3523DL6 -(06 Thru 12)	Rivet, Blind, Universal Head, Monel	CRD-11815	DWG NO CR3523DL

** Commercial and Government Entity

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
CR3552DL4 -(02 Thru 04)	Rivet, Blind, Csk Head, Bulb Type, Monel	CRD-11815	DWG NO CR3552DL
CR3552DL5 -(02 Thru 04)	Rivet, Blind, Csk Head, Bulb Type, Monel	CRD-11815	DWG NO CR3552DL
CR3552DL6 -(02 Thru 05)	Rivet, Blind, Csk Head, Bulb Type, Monel	CRD-11815	DWG NO CR3552DL
CR3553DL4 -(01 Thru 04)	Rivet, Blind, Universal Head, Bulb Type, Monel	CRD-11815	DWG NO CR3553DL
CR3553DL5 -(01 Thru 04)	Rivet, Blind, Universal Head, Bulb Type, Monel	CRD-11815	DWG NO CR3553DL
CR3553DL6 -(01 Thru 05)	Rivet, Blind, Universal Head, Bulb Type, Monel	CRD-11815	DWG NO CR3553DL
SL6061C (02,04,06,08,3)	Insert, Blind, Molded In, Cres	SHL-97393 RXN-29372	DWG SL6061
SL6089 (04,06,08,3)-250	Insert, Thru Hole, Molded In, Aluminum	SHL-97393 RXN-29372	DWG SL6089
SL6096C (04,06,08,3)-250	Insert, Threaded, Molded In, Cres	SHL-97393 RXN-29372	DWG SL6096
ST10049-(1 thru 4,6,8)	Nut, Captive Washer, Self-Locking, Cres	KNR-15653	ST10049
ST10051-(1 Thru 4, 9 Thru 13, 16 Thru 20, 25 Thru 29 40 Thru 44, 50 Thru 53, 70 Thru 72, 81 Thru 84))	Screw, Socket Head, Hexagon, Locking, Cres	LLC-03038	ST10051

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
ST10060-(1 thru 8)	Nut, Hexagon, Self-Locking, Cres, Silver Plated	SPS-56878	ST10060
ST10061-(1 thru 8)	Nut, Hexagon, Self-Locking, Cres, Drylubed	SPS-56878	ST10061
ST10072-(3 Thru 7, 14 Thru 17, 28 Thru 32, 44 Thru 49, 62 Thru 69, 79 Thru 87)	Screw, Pan Head, Cross Recessed, Locking, Cres	LLC-03038	ST10072
ST10073-(4 Thru 7, 16 Thru 19, 29 Thru 33, 45 Thru 49 65 Thru 70, 80 Thru 88, 95 Thru 104)	Screw, Pan Head, Hi-Torque Recessed, Locking, A-286	LLC-03038	ST10073
ST10224-(1,2,3,8,9, 14,15,21,22)	Blind Nut,Rivnut, Flat Head, Closed End, Keyed, Aluminum Alloy	GOE-03481	ST10224
ST10225-(1,2,3,8,9, 14,15,21,22)	Blind Nut,Rivnut, Countersunk Head, Closed End, Keyed, Aluminum Alloy	GOE-03481	ST10225
ST11294-(1,2,3,8,9, 14,15,21,22)	Blind Nut,Rivnut, Flat Head, Open End, Keyed, Aluminum	GOE-03481	ST11294
MS15795-(701 Thru 717,741,742)	Washer, Flat, Metal, Round, General Purpose, Aluminum	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	MS15795

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
MS15795-(801 Thru 803, 805 Thru 817, 842,844,852)	Washer, Flat, Metal, Round, General Purpose, Cres	Open Bid May Incl ANILLO BURBANK AIR H.C. PACIFIC	MS15795
MS16624-(4025,4031, 4037,4043,4050,4056, 4062,4068,4075)	Ring, Retaining, External, Basic (Tapered Section Type) Cres Ph15-7Mo	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16624
MS16625-(4050,4056, 4062,4068,4075,4081, 4087,4093,4100)	Ring, Retaining, Internal, Basic (Tapered Section Type) Cres Ph15-7Mo	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16625
MS16633-(4006,4009, 4012,4015,4018,4025)	Ring, Retaining, External, "E" (Reduced Section Type) Cres Ph15-7Mo	Open Bid May Incl IND RET RING BURBANK AIR H.C. PACIFIC	MS16633
MS16555-(601 Thru 608, 617 Thru 624, 625 Thru 633, 640 Thru 667)	Pins, Straight, Headless, (Dowel), 410 or 416 Cres	Open Bid May Incl SPS-15653 BURBANK AIR H.C. PACIFIC	MS16555
MS21076-(04,06)N	Nut, Self-Locking, Plate, 2 Lug, Floating, Reduced Rivet Spacing	Open Bid May Incl KNR-15653 BURBANK AIR H.C. PACIFIC	MS21076
MS21076L(04,06, 08,3,4,5)N	Nut, Self-Locking, Plate, 2 Lug, Floating, Reduced Rivet Spacing	Open Bid May Incl KNR-15653 BURBANK AIR H.C. PACIFIC	MS21076

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
MS24693C(1 Thru 6, 23 Thru 30, 46 Thru 54, 268 Thru 280)	Screw Mach, Flat, Count, Head, 100 Deg, Cross Recess, Cres	Open Bid May Incl SPS-56878 BURBANK AIR H.C. PACIFIC	MS24693
MS35649-(224, 244,264,284)	Nut, Plain, Hexagon, Machine Screw, UNC-2B, Cres	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35649
MS35650 -(304,3254)	Nut, Plain, Hexagon, Machine Screw, UNF-2B, Cres	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35650
MS35691-(15,23, 31,39,47,55, 63)	Nut, Plain, Hexagon, Machine Screw, UNF-2B, Cres	Open Bid May Incl COLUMBIA NUT BURBANK AIR H.C. PACIFIC	MS35691
MS51957-(1 Thru 7, 11 Thru 17, 25 Thru 32, 42 Thru 49)	Screw, Machine, Pan Head, Cross- Recessed, Cres, UNC-2A	Open Bid May Incl BURBANK AIR H.C. PACIFIC	MS51957
MS51958-(59 Thru 69, 76 Thru 87)	Screw, Machine, Pan Head, Cross- Recessed, Cres, UNC-2A	Open Bid May Incl BURBANK AIR H.C. PACIFIC	MS51958
90273-(4 thru 9, 28)C	Washer, Countersunk, Aluminum	Open Bid May Incl CAL SWISS	DWG 90273
90273-(4 thru 10, 23,26,27,30)F	Washer, Countersunk, Cres	Open Bid May Incl CAL SWISS	DWG 90273

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* Part numbers are shown in numerical order without regard to preceding letters.

Controlling Part Number	Description	Approved Suppliers Code and CAGE** Number	Controlling Documents
KNB(1032,428,524, 624,720,820)J	Insert, Nonlocking, Light Weight, Blind, 303	RXN-29372	REXNORD DWG KNB()J
KNCB(0256,0440, 0632,0832)J	Insert, Nonlocking, Miniature, Blind, 303	RXN-29372	REXNORD DWG KNCB()J
KNHB(0832,1032, 428,524,624,820)J	Insert, Nonlocking, Heavy Duty, Blind	RXN-29372	REXNORD DWG KNHB()J

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Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5. I .3 - Blind Nuts and Inserts

NOTE

Unless otherwise indicated, all units are in inches.

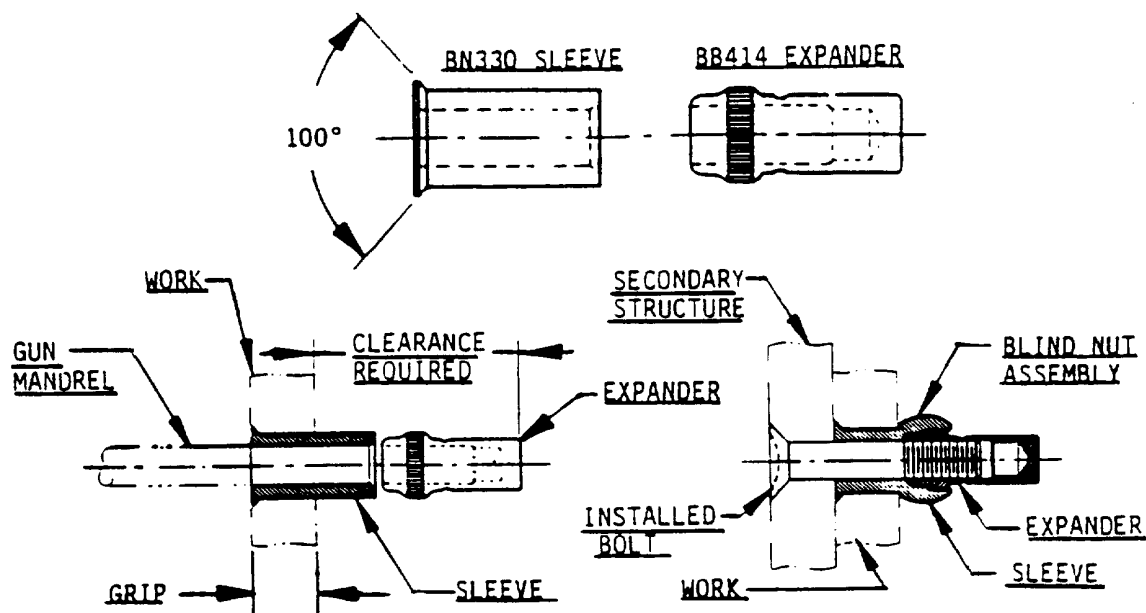
April 1993



JPL D-9984

PREFERRED PART BB 414-Q, BB414GLK-Q AND BN330-QQ

BLIND NUT ASSEMBLY, SLEEVE, 100°C'SUNK SHALLOW HEAD-BLIND
EXPANDER, SELF-LOCKING AND NON-LOCKING CRES



1. SLEEVE: 305 CRES (UNS S30500) CONFORMING TO QQ-S-763, ANNEALED.
2. EXPANDER: A-286 CRES (UNS S66286) IN ACCORDANCE WITH AMS 5731.
3. INSTALLATION CAN BE ACCOMPLISHED WITH ACCESS TO THE TOP SIDE ONLY.
4. DO NOT USE SHORT THREAD BOLTS WITH THIS ASSEMBLY.
5. THESE NUTS DEVELOP THE FULL RATED TENSILE STRENGTH OF 860 MPa (125 KSI) BOLTS AND SCREWS.
6. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.


TEMPERATURE LIMITS:


371°C (700°F)

BB414-Q
BN330-Q-Q


EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
BN330-()-()		BN330-()-()
BN414-()		BN414-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>BOLT SIZE</u>	<u>PREFERRED GRIPS (UP THRU)</u>	<u>SLEEVE CALLOUT</u> 
632	.750	BN330-632-()
832	1.062	BN330-832-()
1032	1.625	BN330-1032-()
428	1.625	BN330-428-()

<u>THREAD UNJQ-3B</u>	<u>EXPANDER CALLOUT</u> 
.1380-32 (C)	BB414-632
.1640-32 (C)	BB414-832
.1900-32 (F)	BB414-1032
.2500-28 (F)	BB414-12

1. DASH NUMBER, IN 1/16THS, INDICATES THE MAXIMUM OF THE GRIP RANGE IN WHICH THE SLEEVE INSTALLED: A"-2" WOULD INDICATE A GRIP RANGE .063 THRU .125.

 CALL OUT THE SLEEVE AND EXPANDER SEPARATELY.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879

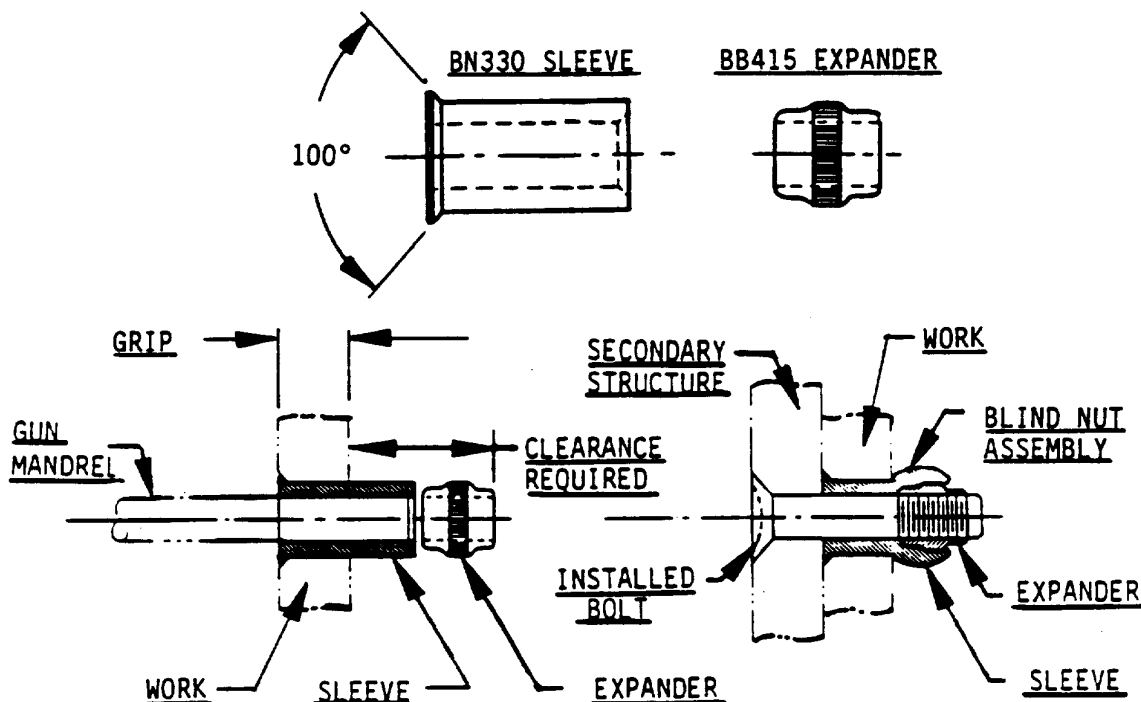
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
HI-SHEAR	73197

BB414-()
BN330-()-()

PREFERRED PART BB 415 NL-0, AND BN330-00

BLIND NUT ASSEMBLY, SLEEVE, 100°C'SUNK SHALLOW HEAD, NON-LOCKING, CRES



1. SLEEVE: 305 CRES (UNS S30500) CONFORMING TO QQ-S-763, ANNEALED.
2. EXPANDER: A-286 CRES (UNS S66286) IN ACCORDANCE WITH AMS 5731.
3. INSTALLATION CAN BE ACCOMPLISHED WITH ACCESS TO THE TOP SIDE ONLY.
4. DO NOT USE SHORT THREAD BOLTS WITH THIS ASSEMBLY.
5. THESE NUTS DEVELOP THE FULL RATED TENSILE STRENGTH OF 860 MPa (125 KSI) BOLTS AND SCREWS.
6. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.


TEMPERATURE LIMITS:


371°C (700°F)

BB415 NL-0
BN330-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
BN330-0-0		BN330-0-0
BN415 NL-0		BN415 NL-0

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>BOLT SIZE</u>	<u>PREFERRED GRIPS (UP THRU)</u>	<u>SLEEVE CALLOUT</u> 
440	.750	BN330-440-0
632	.750	BN330-632-0
832	1.062	BN330-832-0
1032	1.625	BN330-1032-0
428	1.625	BN330-428-0

<u>THREAD UNJ0-3B</u>	<u>EXPANDER CALLOUT</u> 
.1120-40 (C)	BB415NL-5
.1380-32 (C)	BB415NL-632
.1640-32 (C)	BB415NL-8
.1900-32 (F)	BB415NL-1032
.2500-28 (F)	BB415NL-12

1. DASH NUMBER, IN 1/16THS, INDICATES THE MAXIMUM OF THE GRIP RANGE IN WHICH THE SLEEVE INSTALLED: A"-2" WOULD INDICATE A GRIP RANGE .063 THRU .125.

 2. CALL OUT THE SLEEVE AND EXPANDER SEPARATELY.

3. THE EXPANDER USED DETERMINES WHETHER THE ASSEMBLY IS LOCKING OR NONLOCKING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879

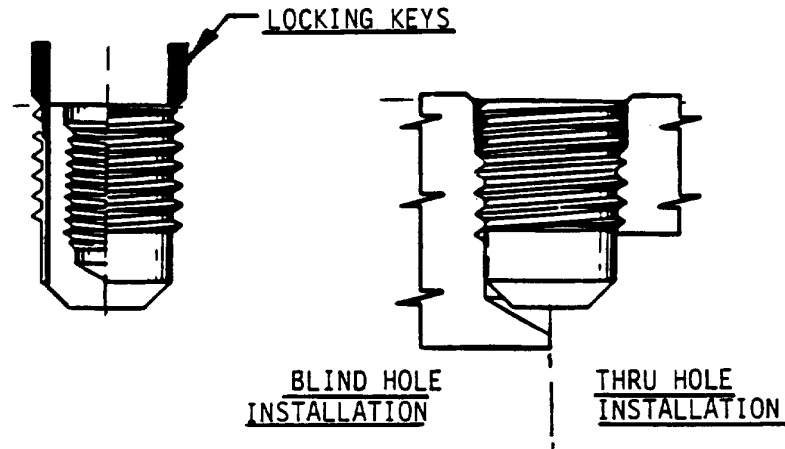
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
HI-SHEAR	73197

BB414 NL-0
BN330-0-0

PREFERRED PART KNBQJ

INSERT, THREADED, LIGHTWEIGHT, BLIND END, KEE LOCKED, NON SELF-LOCKING, UNJF-3B INTERNAL THREAD.



1. CRES 303 (USN S30300) PASSIVATED IN ACCORDANCE WITH ASTM A380. LOCKING KEES ARE 302 CRES (UNS S30200).
2. USE OPEN ENDED INSERTS WHERE PRACTICAL.
3. USE THESE INSERTS WHERE IT IS IMPORTANT TO KEEP SCREWS ISOLATED FROM CERTAIN ASSEMBLIES, SUCH AS ELECTRONIC CIRCUITRY.
4. INSTALL IN ACCORDANCE WITH MS51835.

TEMPERATURE LIMITS:

427°C (800°F)

KNBQJ

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
KNBQJ		KNBQJ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE, UNJF-3B</u>	<u>PART NO.</u>
.1900-32	KNB1032J
.2500-28	KNB428J
.3125-24	KNB524J
.3750-24	KNB624J
.4375-20	KNB720J
.5000-20	KNB820J

1. FOR SMALLER THREAD SIZES, USE KNBCQJ SERIES

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879
MIL-I-45914

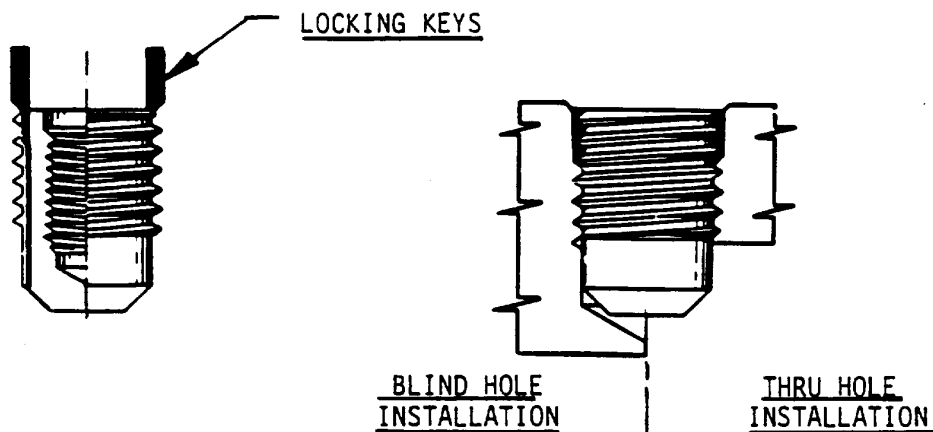
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
TRIDAIR	29372

KNBQJ

PREFERRED PART KNCBQJ

INSERT, THREADED, MINIATURE, BLIND END, KEE LOCKED, NON SELF-LOCKING, UNJF-3B INTERNAL THREAD.



1. CRES 303 (USN S30300) PASSIVATED IN ACCORDANCE WITH ASTM A380. LOCKING KEES ARE 302 CRES (UNS S30200).
2. USE OPEN ENDED INSERTS WHERE PRACTICAL.
3. USE THESE INSERTS WHERE IT IS IMPORTANT TO KEEP A SCREW ISOLATED FROM CERTAIN ASSEMBLIES, SUCH AS ELECTRONIC CIRCUITRY.
4. INSTALL IN ACCORDANCE WITH MS51835.

TEMPERATURE LIMITS:

427°C (800°F)

KNCBQJ

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
KNCBQJ		KNCBQJ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

THREAD
SIZE, UNJC-3B

PART NO.

.0860-56
.1120-40
.1380-32
.1640-32

KNCB0256J
KNCB0440J
KNCB0632J
KNCB0832J

1. FOR LARGER THREAD SIZES, USE KNCBQJ SERIES

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879
MIL-I-45914

SUPPLIERS:

MFR

CAGE

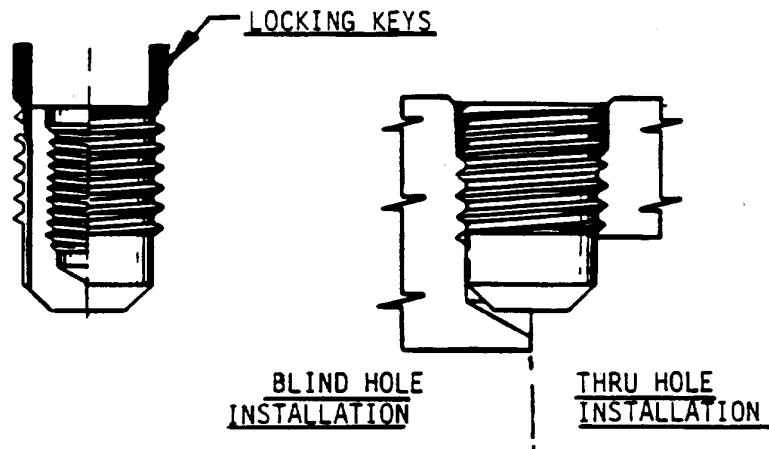
TRIDAIR

29372

KNCBQJ

PREFERRED PART KNHBQJ

INSERT, THREADED, CRES. KEE LOCKED, HEAVY DUTY, NON SELF-LOCKING, UNJQ-3B INTERNAL THREADS.



1. INSERTS ARE 303 CRES (UNS S30300) PASSIVATED ASTM A380.
2. HEAVY DUTY INSERTS HAVE LARGER SHEAR ENGAGEMENT AREAS DUE TO THE LARGER EXTERNAL THREADS, THE LARGER SHEAR AREAS INCREASE PULL-OUT STRENGTH OF THE INSERT.
3. INSTALL IN ACCORDANCE WITH MS51835.

TEMPERATURE LIMITS:

427°C (800°F)

KNHBQJ

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
KNHBQJ		KNHBQJ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

THREAD
SIZE-3B

PART NUMBER

.1640-32 UNJC	KNHB0832J
.1900-32 UNJF	KNHB1032J
.2500-28 UNJF	KNHB428J
.3125-24 UNJF	KNHB524J
.3750-24 UNJF	KNHB624J
.5000-20 UNJF	KNHB820J

1. SIZES .3125 AND LARGER HAVE 4 KEES

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

CAGE

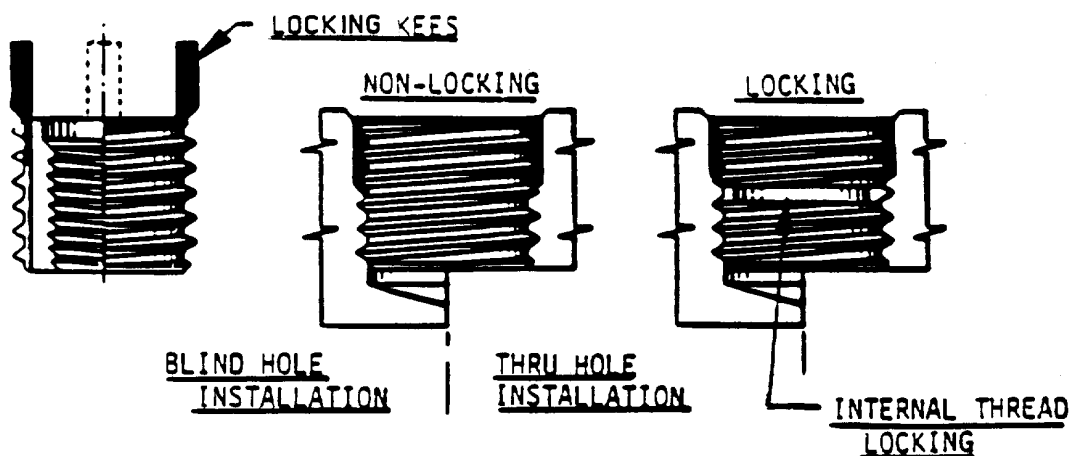
TRIDAIR

29372

KNHBQJ

PREFERRED PART NAS1394C0

INSERT, THREADED METAL, SELF-LOCKING AND NON-SELF-LOCKING CRES,
UNJ0-3B INTERNAL THREAD.



1. INSERTS ARE 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35. THESE INSERTS ARE NOT SOLID FILM OR OTHERWISE LUBED.
- 2.4 WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

427°C (800°F)

NAS1394C0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
NAS1394CQ		KNQJ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

PART NUMBERS

THREAD
SIZE-3B

.1640-32 UNJC
.1900-32 UNJF
.2500-28 UNJF
.3125-24 UNJF
.3750-24 UNJF
.4375-20 UNJF
.5000-20 UNJF


NAS1394C3
NAS1394C4
NAS1394C5
NAS1394C6
NAS1394C7
NAS1394C8

1. SIZES .3125-24 AND LARGER HAVE 4 LOCKING KEES.



2. NON-SELF-LOCKING, PREFERRED PARTS, SEE ST11326 FOR SIZES 2-56 THRU 8-32.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	NAS1394
MIL-S-7742	MS51830
MIL-N-25027	

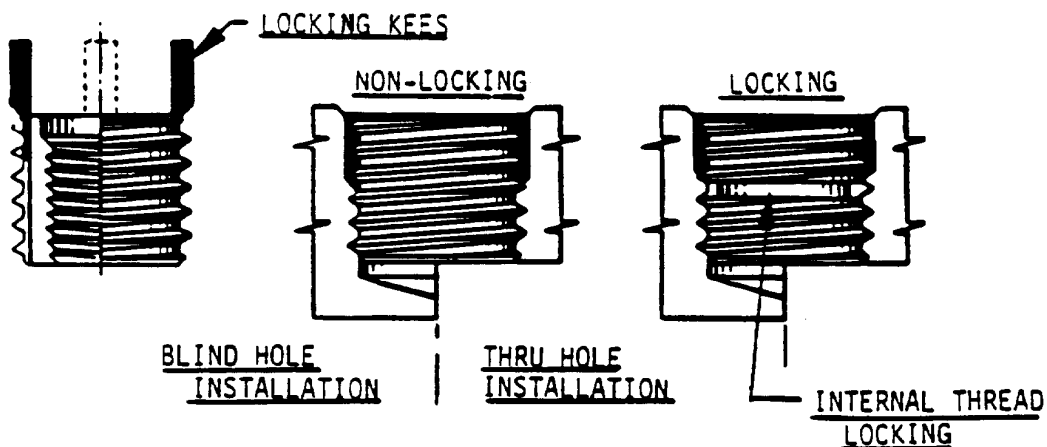
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
TRIDAIR	29372

NAS1394CQ

PREFERRED PART NAS1395C0LSN AND NAS1395C0

INSERT, THREADED METAL, HEAVY DUTY, SELF-LOCKING AND NON-SELF-LOCKING CRES. UNJ0-3B INTERNAL THREAD.



1. INSERTS ARE 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35. THESE INSERTS ARE NOT SOLID FILM OR OTHERWISE LUBED.
2. THESE HEAVY DUTY INSERTS HAVE SHEAR ENGAGEMENT AREAS LARGER THAN MS51830 AND NAS1394 DUE TO LARGER EXTERNAL THREADS WHICH INCREASES THE PULL-OUT STRENGTH.
3. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

427°C (800°F)

NAS1395C0LSN
NAS1395C0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
NAS1395C()		KNH()J

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

**THREAD
SIZE-3B**

PART NUMBERS

.1120-40 UNJC	NAS1395C04
.1380-32 UNJC	NAS1395C06
.1640-32 UNJC	NAS1395C08
.1900-32 UNJF	NAS1395C3
.2500-28 UNJF	NAS1395C4
.3125-24 UNJF	NAS1395C5
.3750-24 UNJF	NAS1395C6
.4375-20 UNJF	NAS1395C7
.5000-20 UNJF	NAS1395C8

1. SIZES .3125-24 AND LARGER HAVE 4 LOCKING KEES.
2. NON-SELF-LOCKING, PREFERRED PARTS, SEE ST11326 FOR SIZES 2-56 THRU 8-32.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	NAS1395
MIL-S-7742	MS51831
MIL-N-25027	

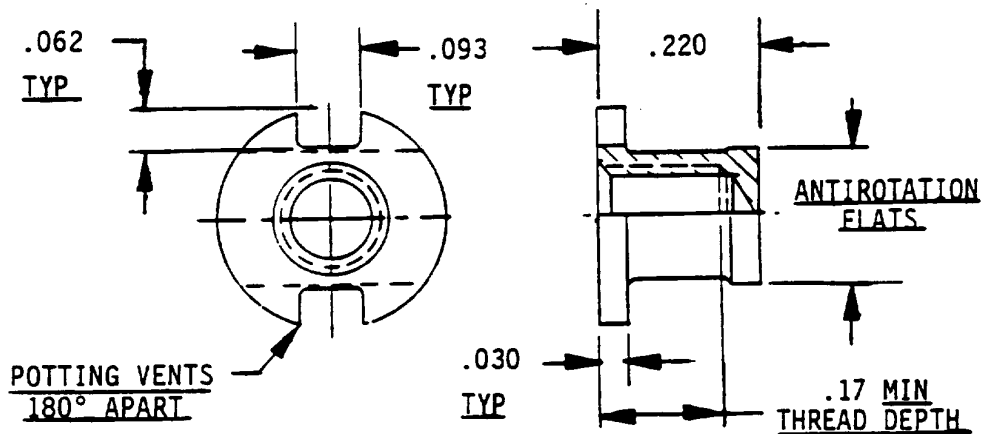
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
TRIDAIR	29372

NAS1395C()

PREFERRED PART SL6061C0

INSERT, HONEYCOMB PANEL, LIGHT WEIGHT, THREADED, NON SELF-LOCKING, CRES



1. MATERIAL IS 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. THESE PARTS ARE SUPPLIED WITH AN ADHESIVE TAB THAT HOLDS THE INSERT IN PLACE WHILE THE POTTING MATERIAL IS INJECTED AND CURED.
3. THESE INSERTS CAN BE INSTALLED IN 6.35 mm (.250 INCH) AND THICKER HONEYCOMB PANELS.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

427°C (800°F)

SL6061C0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
SL6061C()		SL6061C()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>SL6061C DASH NO.</u>
.0860-56 UNJC-3B	02
.1120-40 UNJC-3B	04
.1380-32 UNJC-3B	06
.1640-32 UNJC-3B	08
.1900-32 UNJF-3B	3

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879

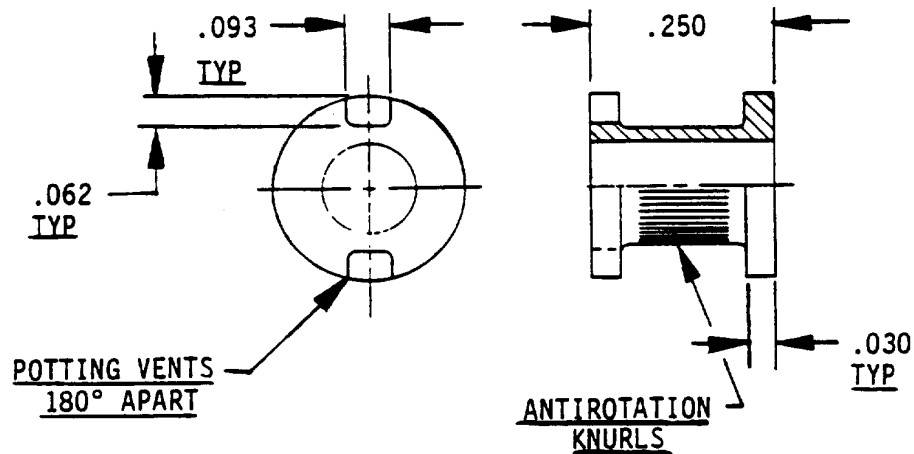
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
SHUR-LOK CORP	97393

SL6061C()

PREFERRED PART SL6089A0-250

INSERT, HONEYCOMB PANEL, LIGHT WEIGHT, CLEARANCE HOLE,
ALUMINUM



1. MATERIAL IS 2024-T4 ALUMINUM ALLOY CONFORMING TO QQ-A-225/6. ANODIZED IN ACCORDANCE WITH MIL-A-8625, 1A, CLASS 1.
2. THESE PARTS ARE SUPPLIED WITH AN ADHESIVE TAB THAT HOLDS THE INSERT IN PLACE WHILE THE POTTING MATERIAL IS INJECTED AND CURED.
3. THESE INSERTS ARE DESIGNED FOR USE IN 6.35 mm (.250 INCH) THICK PANELS ONLY.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

93°C (200°F)

SL6089A0-250

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
SL6089A()-250		SL6089A()-250

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

BOLT/SCREW
SIZE-3B

SL6089A()-250
DASH NUMBER

.1120 UNJC
.1380 UNJC
.1640 UNJC
.1900 UNJF

04
06
08
3

APPLICABLE SPECIFICATIONS AND STANDARDS:

SUPPLIERS:

MFR

CAGE

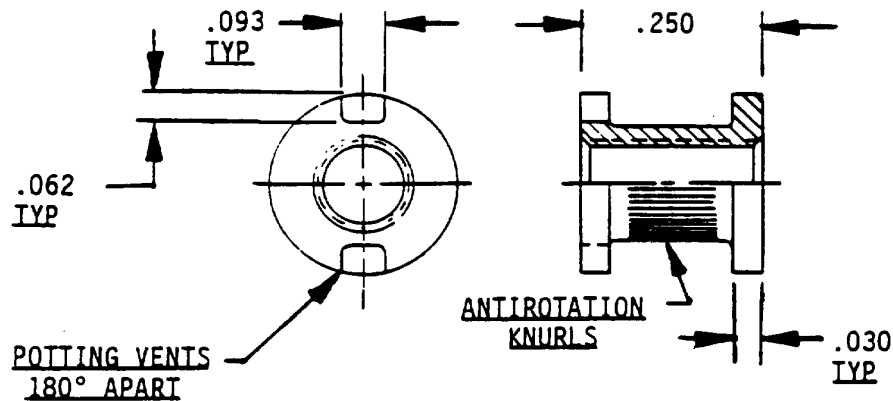
SHUR-LOK CORP.

97393

SL6089A()-250

PREFERRED PART SL6096CQ-250

INSERT, HONEYCOMB PANEL, THRU THREADED, NON SELF-LOCKING, CRES



1. MATERIAL IS 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. THESE PARTS ARE SUPPLIED WITH AN ADHESIVE TAB THAT HOLDS THE INSERT IN PLACE WHILE THE POTTING MATERIAL IS INJECTED AND CURED.
3. THESE INSERTS ARE DESIGNED FOR USE IN 6.35 mm (.250 INCH) THICK PANELS ONLY.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

427°C (800°F)

SL6096CQ-250

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
SL6096C()-250		SL6096C()-250

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>SL6096C()-250 DASH NUMBER</u>
.1120-40 UNJC-3B	04
.1380-32 UNJC-3B	06
.1640-32 UNJC-3B	08
.1900-32 UNJF-3B	3

1. PARTS SHALL NOT BE LUBED OR COATED

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879

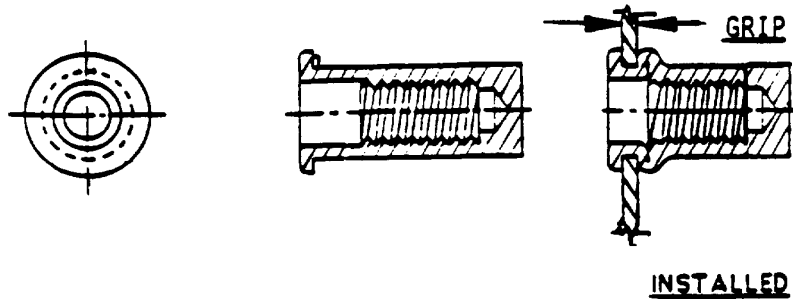
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
SHUR-LOK CORP.	97393

SL6089A()-250

PREFERRED PART ST10224-0

BLIND NUT (RIVNUT), FLAT HEAD, CLOSED END, KEYED, ALUMINUM
ALLOY, NON SELF-LOCKING



1. MATERIAL IS 6053-T4 ALUMINUM ALLOY ANODIZED (ALUMILITE NO. 205) IN ACCORDANCE WITH MIL-A-8625.
2. TENSILE STRENGTH 170 MPa (25 KSI) ULTIMATE.
3. SPECIAL INSTALLATION HOLE REQUIREMENTS, SEE ST10224 DRAWING.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

121°C (250°F)

ST10224-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10224-0		A0KB0

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

THREAD SIZE-3B	GRIP RANGE	SUPPLIERS NUMBER	ST10224 DASH NUMBER
.1120-40 UNC	.010-.060	A4KB60	1
	.060-.085	A4KB85	2
	.085-.110	A4KB110	3
.1380-32 UNC	.075-.120	A6KB120	8
	.120-.160	A6KB160	9
.1640-32 UNC	.075-.120	A8KB120	14
	.120-.160	A8KB160	15
.1900-32 UNF	.130-.180	A10KB180	21
	.180-.230	A10KB230	22

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-7742 ST10224

SUPPLIERS:

MFR

CAGE

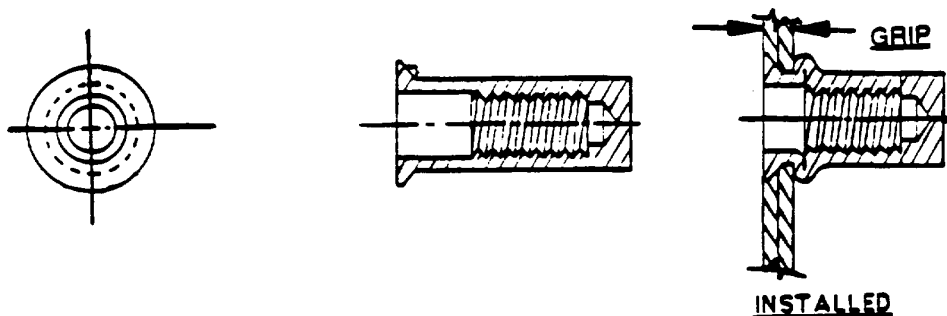
B.F. GOODRICH CO.

03481

ST10224-0

PREFERRED PART ST10225-Q

BLIND NUT (RIVNUT), COUNTERSUNK HEAD, CLOSED END, KEYED,
ALUMINUM ALLOY, NON SELF-LOCKING



1. MATERIAL IS 6053-T4 ALUMINUM ALLOY ANODIZED (ALUMILITE NO. 205) IN ACCORDANCE WITH MIL-A-8625.
2. TENSILE STRENGTH 170 MPa (25 KSI) ULTIMATE.
3. SPECIAL INSTALLATION HOLE REQUIREMENTS, SEE ST10225 DRAWING.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

121°C (250°F)

SL10225-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10225-Q		AQKBQ

THREAD SIZE-3B	GRIP RANGE	SUPPLIERS NUMBER	ST10225 DASH NUMBER
.1120-40 UNC	.050-.081	A4KB81	1
	.081-.106	A4KB106	2
	.106-.131	A4KB131	3
.1380-32 UNC	.106-.161	A6KB161	8
	.161-.201	A6KB201	9
.1640-32 UNC	.106-.161	A8KB161	14
	.161-.201	A8KB201	15
.1900-32 UNF	.166-.216	A10KB216	21
	.216-.266	A10KB266	22

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-7742 ST10225

SUPPLIERS:MFRCAGE

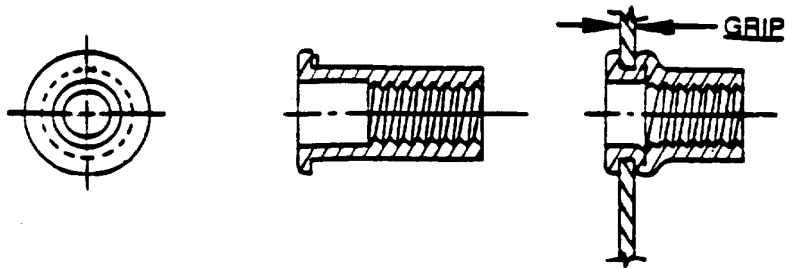
B.F. GOODRICH CO.

03481

ST10225-Q

PREFERRED PART ST11294-Q

BLIND NUT (RIVNUT), FLAT HEAD, OPEN END, KEYED, ALUMINUM ALLOY,
NON SELF-LOCKING



INSTALLED

1. MATERIAL IS 6053-T4 ALUMINUM ALLOY ANODIZED (ALUMILITE NO. 205) IN ACCORDANCE WITH MIL-A-8625.
2. TENSILE STRENGTH 170 MPa (25 KSI) ULTIMATE.
3. SPECIAL INSTALLATION HOLE REQUIREMENTS, SEE ST11294 DRAWING.
4. WHEN SELF-LOCKING BOLTS ARE USED WITH THESE PARTS, SPECIFY BOLTS WITH SOLID FILM LUBE.

TEMPERATURE LIMITS:

121°C (250°F)

ST11294-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST11294-Q		A0K0

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

THREAD SIZE-3B	GRIP RANGE	SUPPLIERS NUMBER	ST11294 DASH NUMBER
.1120-40 UNC	.010-.060	A4K60	1
	.060-.085	A4K85	2
	.085-.110	A4K110	3
.1380-32 UNC	.075-.120	A6K120	8
	.120-.160	A6K160	9
.1640-32 UNC	.075-.120	A8K120	14
	.120-.160	A8K160	15
.1900-32 UNF	.130-.180	A10K180	21
	.180-.230	A10K320	22

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-7742 ST11294

SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
B.F. GOODRICH CO.	03481

ST11294-Q

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5.1.4 - Blind Rivets

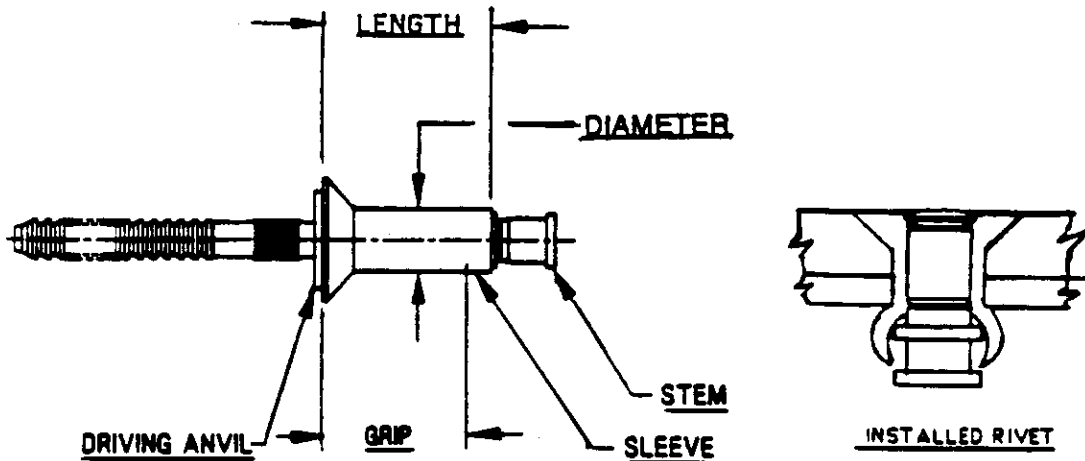
April 1993



JPL D-9984

PREFERRED PART CR3222DL-0-0

RIVET, BLIND, NOMINAL DIAMETER, (WIREDRAW), 100°C SUNK HEAD, LOCKED STEM, ALUMINUM



1. SINGLE SHEAR STRENGTH 345 MPa (50,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE RIVETS ARE WIREDRAW TYPES AND PROVIDE GOOD HOLE FILL UPON INSTALLATION.
5. THIN ALUMINUM BOTTOM SHEETS IN SHEET STACK UPS MAY CAUSE INTERRIVET BUCKLING AND PILLOWING. CONSULT COGNIZANT ENGINEER.
6. MATERIALS:

SLEEVE -- 5056 (UNS A95056) ALUMINUM, CHEM FILM MIL-C-5546
STEM -- 15-7PH (UNS S15700) CRES, SOLID FILM LUBE DICRONITE
COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

121°C (250°F)

CR3222DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3222DL-()-()		CR3222DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(05, 06)
5	(05 THRU 08)
6	(06 THRU 12)

1. DIAMETERS IN 1/32 INCREMENTS - $4 = 4/32 = .125$ DIA.
2. GRIP LENGTH IN 1/16 INCREMENTS - $08 = 8/16 = .500$ MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3222DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1399	MIL-R-7885
NAS1400	CR3222DL
	M7885/3

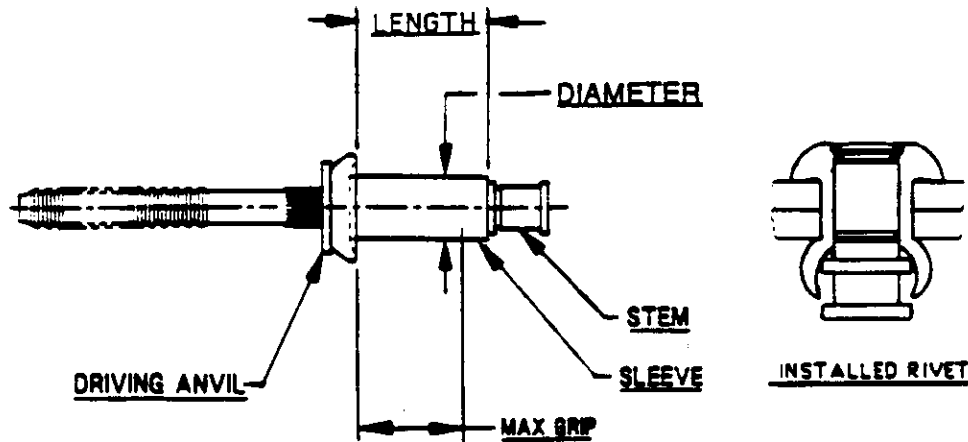
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3222DL-()-()

PREFERRED PART CR3223DL-0-0

RIVET, BLIND, NOMINAL DIAMETER, (WIRE DRAW), UNIVERSAL HEAD,
LOCKED STEM, ALUMINUM ALLOY



1. SINGLE SHEAR STRENGTH 345 MPa (50,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE RIVETS ARE WIREDRAW TYPES AND PROVIDE GOOD HOLE FILL UPON INSTALLATION.
5. THIN ALUMINUM BOTTOM SHEETS IN SHEET STACK UPS MAY CAUSE INTERRIVET BUCKLING AND PILLOWING. CONSULT COGNIZANT ENGINEER.
6. DL INDICATES DICRONITE SOLID FILM LUBE.
7. MATERIALS:

SLEEVE -- 5056 (UNS A95056) ALUMINUM, CHEM FILM MIL-C-5546
STEM -- 15-7PH (UNS S15700) CRES, SOLID FILM LUBE DICRONITE
COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

121°C (250°F)

CR3223DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3223DL-()-()		CR3223DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(05, 06)
5	(05 THRU 08)
6	(06 THRU 12)

1. DIAMETERS IN 1/32 INCREMENTS - $4 = 4/32 = .125$ DIA.
2. GRIP LENGTH IN 1/16 INCREMENTS - $08 = 8/16 = .500$ MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3223DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1398	CR3223DL
NAS1400	M7885/2
MIL-R-7885	

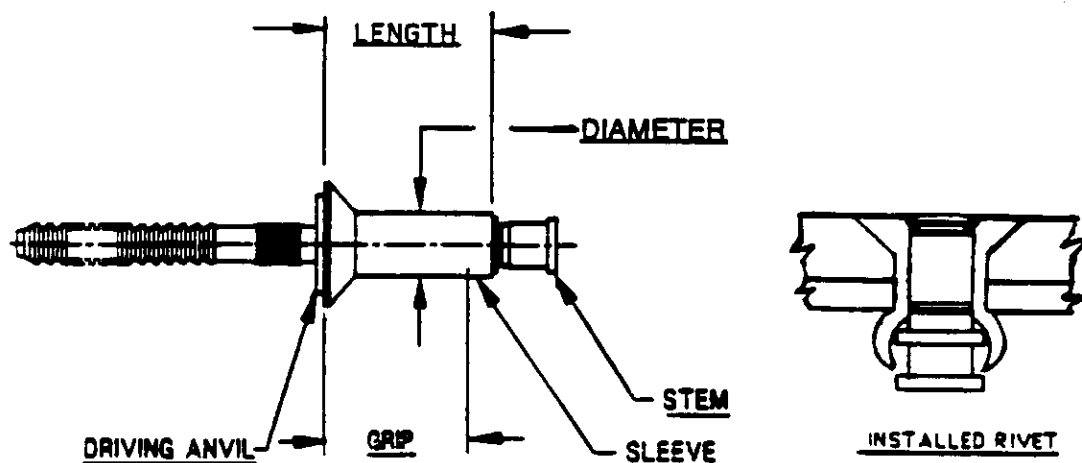
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3223DL-()-()

PREFERRED PART CR3252DL-0-0

RIVET, BLIND, OVERSIZE DIAMETER, (BULB TYPE), 100°C SUNK HEAD, LOCKED STEM, ALUMINUM ALLOY



1. SINGLE SHEAR STRENGTH 345 MPa (50,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE ARE "BULB" RIVETS, WHICH FORM LARGE UPSET HEADS WITHOUT DISTORTING THE BOTTOM SHEET. THEY ARE RECOMMENDED FOR USE IN THIN GRIPS AND WHERE THIN SHEETS ARE ON THE BACK OF THE STACK UPS.
5. DL INDICATES DICRONITE SOLID FILM LUBE.
6. MATERIALS:

SLEEVE -- 5056 (UNS A95056) ALUMINUM, CHEM FILM MIL-C-5541
STEM -- 15-7PH (UNS S15700) CRES, SOLID FILM LUBE DICRONITE
COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

121°C (250°F)

CR3252DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3252DL-()-()		CR3252DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(02 THRU 04)
5	(02 THRU 04)
6	(02 THRU 05)

1. DIA.S: 4 = .140 5 = .173 6 = .201
2. GRIP LENGTH IN 1/16 INCREMENTS - 04 = 4/16 = .250 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3252DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1738	CR3252DL
NAS1740	

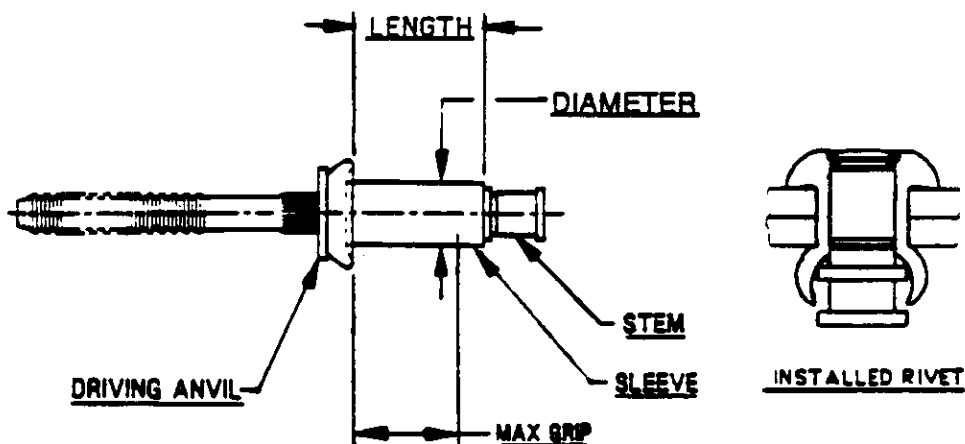
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3252DL-()-()

PREFERRED PART CR3253DL-0-0

RIVET, BLIND, OVERSIZE DIAMETER, (BULB TYPE), UNIVERSAL HEAD, LOCKED STEM, ALUMINUM ALLOY



1. SINGLE SHEAR STRENGTH 345 MPa (50,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE ARE "BULB" RIVETS, WHICH FORM LARGE UPSET HEADS WITHOUT DISTORTING THE BOTTOM SHEET. THEY ARE RECOMMENDED FOR USE IN THIN GRIPS AND WHERE THIN SHEETS ARE ON THE BACK OF THE STACK UPS.
5. DL INDICATES DICRONITE SOLID FILM LUBE.
6. MATERIALS:

SLEEVE -- 5056 (UNS A95056) ALUMINUM, CHEM FILM MIL-C-5541
STEM -- 15-7PH (UNS S15700) CRES, SOLID FILM LUBE DICRONITE
COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

121°C (250°F)

CR3253DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3253DL-()-()		CR3253DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(01 THRU 04)
5	(01 THRU 04)
6	(01 THRU 05)

1. DIA.S: 4 = .140 5 = .173 6 = .201
2. GRIP LENGTH IN 1/16 INCREMENTS - 04 = 4/16 = .250 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3253DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1738 CR3253DL
NAS1740

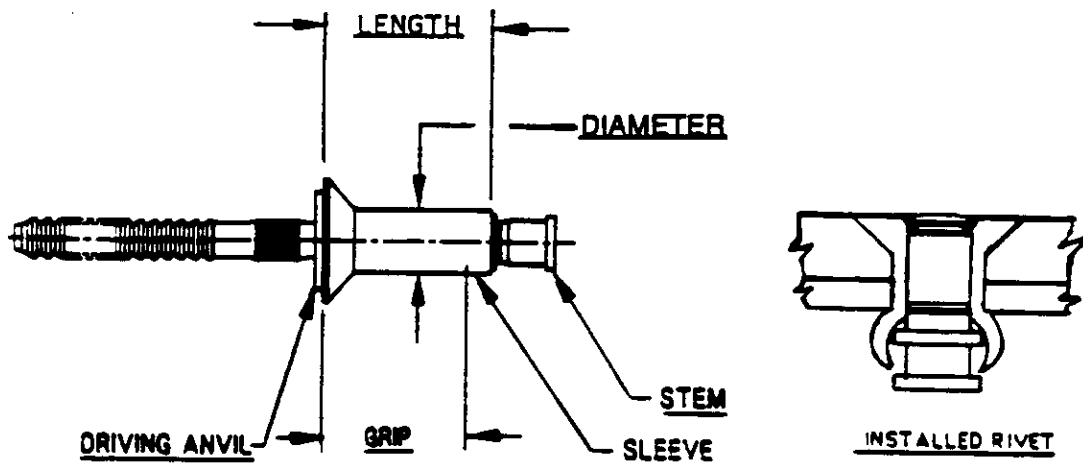
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3253DL-()-()

PREFERRED PART CR3522DL-0-0

RIVET, BLIND, NOMINAL DIAMETER, (WIREDRAW), 100°C' SUNK HEAD, LOCKED STEM, MONEL



1. SINGLE SHEAR STRENGTH 518 MPa (75,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE RIVETS ARE WIREDRAW TYPES, AND PROVIDE GOOD HOLE FILL UPON INSTALLATION.
5. THIN ALUMINUM BOTTOM SHEETS IN SHEET STACK UPS MAY CAUSE INTER RIVET BUCKLING AND PILLOWING. CONSULT COGNIZANT ENGINEER.
6. MATERIALS:

SLEEVE -- MONEL (UNS N04400) BARE

STEM -- 15-7PH (UNS S15700) CRES. DICRONITE SOLID FILM LUBE

COLLAR -- A-286 (UNS S66286) CRES. PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

371°C (700°F)

CR3522DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3522DL-()-()		CR3522DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(05, 06)
5	(05 THRU 08)
6	(06 THRU 12)

1. DIAMETERS IN 1/32 INCREMENTS -4 = 4/32 = .125 DIA.
2. GRIP LENGTH IN 1/16 INCREMENTS - 08 = 8/16 = .500 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3522DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1399	CR3522DL
NAS1400	MIL-R-7885/5
MIL-R-7885	

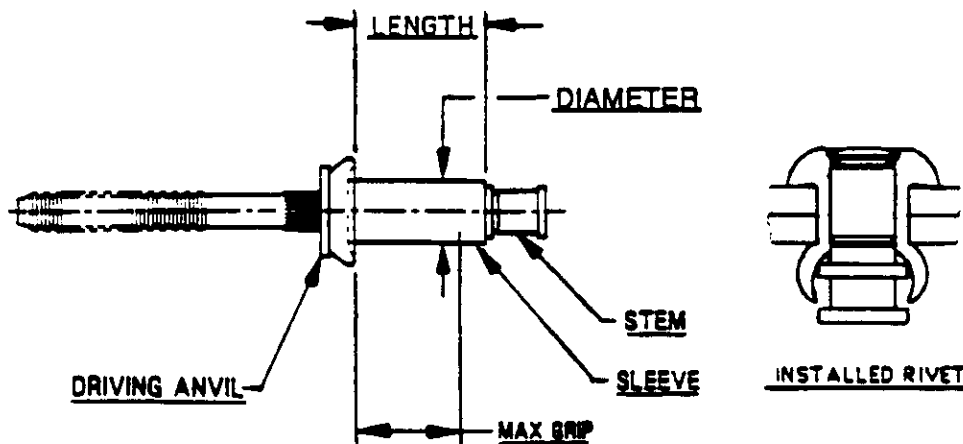
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3522DL-()-()

PREFERRED PART CR3523DL-0-0

RIVET, BLIND, NOMINAL DIAMETER, (WIREDRAW), UNIVERSAL HEAD,
LOCKED STEM, MONEL



1. SINGLE SHEAR STRENGTH 518 MPa (75,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE RIVETS ARE WIREDRAW TYPES, AND PROVIDE GOOD HOLE FILL UPON INSTALLATION.
5. THIN ALUMINUM BOTTOM SHEETS IN SHEET STACK UPS MAY CAUSE INTER RIVET BUCKLING AND PILLOWING. CONSULT COGNIZANT ENGINEER.
6. MATERIALS:

SLEEVE -- MONEL (UNS N04400) BARE
STEM -- 15-7PH (UNS S15700) CRES, DICRONITE SOLID FILM LUBE
COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

371°C (700°F)

CR3523DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3523DL-()-()		CR3523DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(05, 06)
5	(05 THRU 08)
6	(06 THRU 12)

1. DIAMETERS IN 1/32 INCREMENTS -4 = 4/32 = .125 DIA.
2. GRIP LENGTH IN 1/16 INCREMENTS - 08 = 8/16 = .500 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3523DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1398	CR3523DL
NAS1400	MIL-R-7885/4
MIL-R-7885	

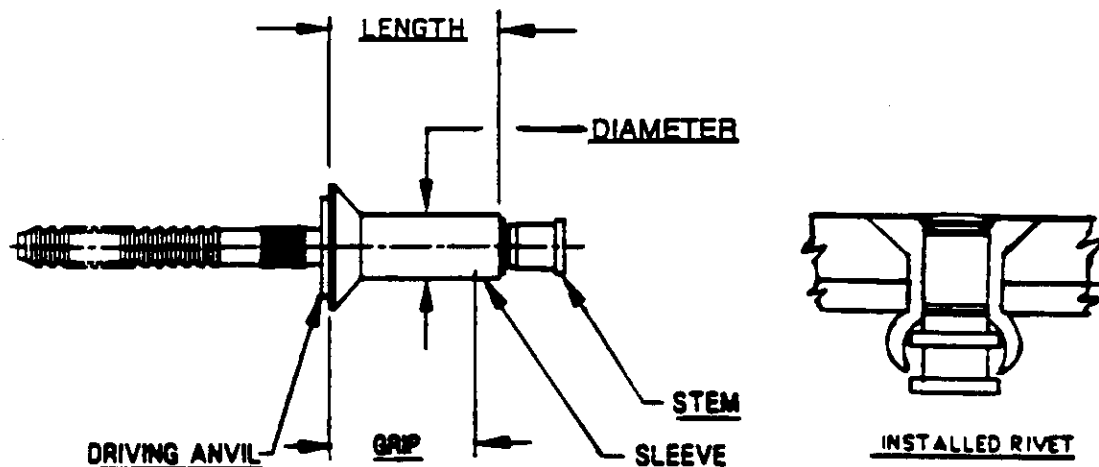
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3523DL-()-()

PREFERRED PART CR3552DL-0-0

RIVET, BLIND, OVERSIZE DIAMETER, (BULB TYPE), 100°C' SUNK HEAD, LOCKED STEM, MONEL



1. SINGLE SHEAR STRENGTH 518 MPa (75,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE ARE "BULB" RIVETS, WHICH FORM LARGE UPSET HEADS WITHOUT DISTORTING THE BOTTOM SHEET. THEY ARE RECOMMENDED FOR USE IN THIN GRIPS AND WHERE THIN SHEETS ARE ON THE BACK OF THE STACK UPS.
5. DL INDICATES DICRONITE SOLID FILM LUBE.
6. MATERIALS:

SLEEVE -- MONEL (UNS N04400) BARE

STEM -- 15-7PH (UNS S15700) CRES, DICRONITE SOLID FILM LUBE

COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

371°C (700°F)

CR3552DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3552DL-()-()		CR3552DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(02 THRU 04)
5	(02 THRU 04)
6	(02 THRU 05)

1. DIA. S: 4 = .140 5 = .173 6 = .201
2. GRIP LENGTH IN 1/16 INCREMENTS - 04 = 4/16 = .250 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3552DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1738	CR3552DL
NAS1740	M7885/9
MIL-R-7885	

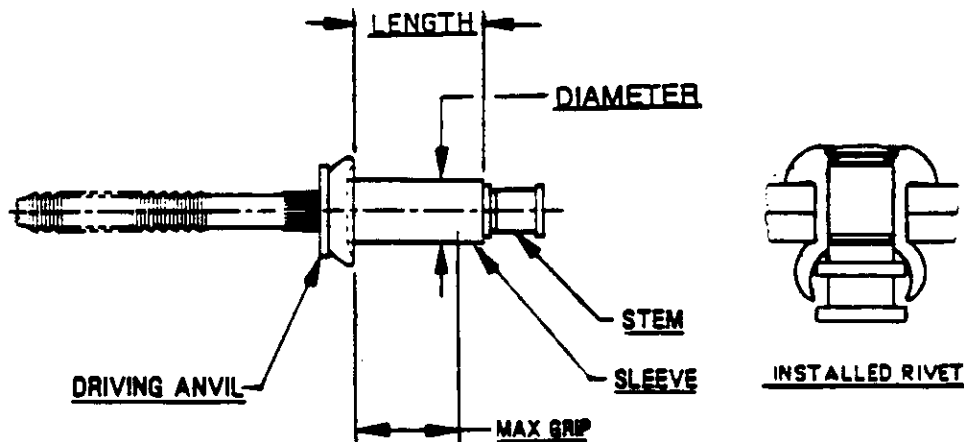
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3552DL-()-()

PREFERRED PART CR3553DL-0-0

RIVET, BLIND, OVERSIZE DIAMETER, (BULB TYPE), UNIVERSAL HEAD,
LOCKED STEM, MONEL



1. SINGLE SHEAR STRENGTH 518 MPa (75,000 PSI) ULTIMATE.
2. USE GIVEN SHEAR STRENGTH AS A GUIDE ONLY. ACTUAL PER RIVET LOADS VARY WITH DIFFERENT GRIPS AND DIAMETERS.
3. USE MIL-HDBK-5 DESIGN ALLOWABLES.
4. THESE ARE "BULB" RIVETS, WHICH FORM LARGE UPSET HEADS WITHOUT DISTORTING THE BOTTOM SHEET. THEY ARE RECOMMENDED FOR USE IN THIN GRIPS AND WHERE THIN SHEETS ARE ON THE BACK OF THE STACK UPS.
5. DL INDICATES DICRONITE SOLID FILM LUBE.
6. MATERIALS:

SLEEVE -- MONEL (UNS N04400) BARE

STEM -- 15-7PH (UNS S15700) CRES, DICRONITE SOLID FILM LUBE

COLLAR -- A-286 (UNS S66286) CRES, PASSIVATE QQ-P-35.

TEMPERATURE LIMITS:

371°C (700°F)

CR3553DL-0-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
CR3553DL-()-()		CR3553DL-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>
4	(01 THRU 04)
5	(01 THRU 04)
6	(01 THRU 05)

1. DIA. S: 4 = .140 5 = .173 6 = .201
2. GRIP LENGTH IN 1/16 INCREMENTS - 04 = 4/16 = .250 MAX GRIP.
3. FOR COMPLETE DIMENSIONING, SEE CHERRY DRAWING CR3553DL.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS1738	CR3553DL
NAS1740	M7885/9
MIL-R-7885	

SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
CHERRY	11815

CR3553DL-()-()

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5.1.5 - Nuts

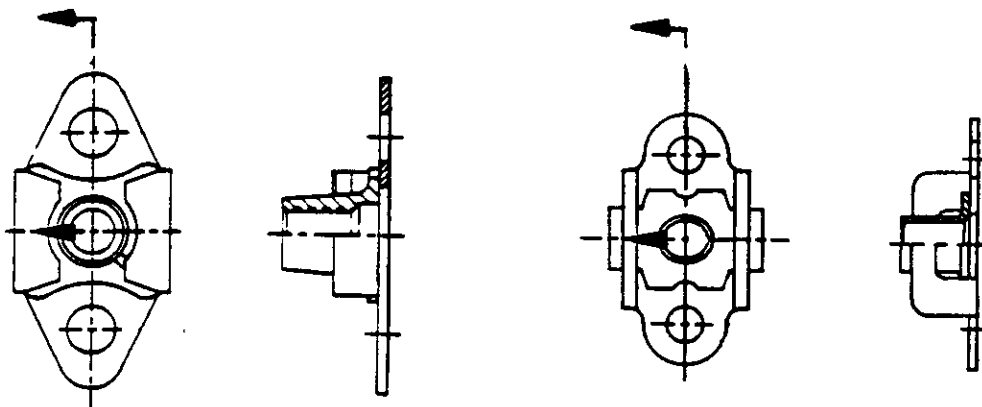
April 1993



JPL D-9984

PREFERRED PART MS21076-QN & MS21076LQN

NUT, SELF-LOCKING, PLATE, TWO LUG, FLOATING, REDUCED RIVET
SPACING, CRES



ALTERNATE CONFIGURATIONS

1. THESE NUTS DEVELOP THE FULL RATED TENSILE STRENGTHS OF 860 MPa (125,000 PSI) BOLTS AND SCREWS, WHEN USED WITH 1100 MPa (160,000 PSI) OR HIGHER STRENGTH BOLTS AND SCREWS.
2. NUT AND BASKET ARE A-286 CRES (UNS S66286) IN ACCORDANCE WITH AMS5525, AMS5735 OR AMS5737.
3. WHEN DESIGNATED BY A "-" IN THE PART NUMBER, THE NUT ELEMENT IS SILVER PLATED IN ACCORDANCE WITH AMS2410.
4. AN "L" DESIGNATES SOLID FILM LUBE CONFORMING TO MIL-L-46010. THESE NUTS ARE LIMITED TO 5 REUSE CYCLES.
5. THESE NUTS HAVE A MAGNETIC PERMEABILITY OF LESS THAN 2.0 (AIR = 1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

A-286 AND SILVER 438°C (800°F)
SOLID FILM LUBE 216°C (400°F)

MS21076-QN
MS21076LQN

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS21076-QN	MS21076-QN	MS21076-QN
MS21076LQN	MS21076LQN	MS21076LQN

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE-3B</u>	<u>SOLID FILM LUBED</u>	<u>SILVER PLATED</u>
.1120-40 UNJC	MS21076L04N	MS21076-04N
.1380-32 UNJC	MS21076L06N	MS21076-06N
.1640-32 UNJC	MS21076L08N	
.1900-32 UNJF	MS21076L3N	
.2500-28 UNJF	MS21076L4N	
.3125-24 UNJF	MS21076L5N	

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	MS21076
MIL-N-25027	NAS1068

SUPPLIERS:

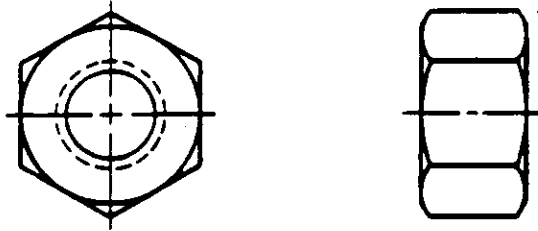
OPEN BID MAY INCLUDE

<u>MFR</u>	<u>CAGE</u>
HARVARD	72962
KAYNAR	15653
REPUBLIC	52828

MS21076-QN
MS21076LQN

PREFERRED PART MS35649 & MS35650

NUT, HEXAGONAL, NON-LOCKING, MACHINE CRES



1. THESE NUTS ARE TO BE USED IN NON-STRUCTURAL APPLICATION ONLY.
2. THESE NUTS ARE NOT SELF-LOCKING.
3. USE CRES NUTS WITH CRES BOLT AND SCREWS.
4. MAGNETIC PERMEABILITY IS LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
5. DRAWING CALLOUT: MS35649-($\triangle 6$) OR MS35650-($\triangle 6$)

$\triangle 6$. INDICATES MATERIAL, PLATING, AND SIZE. ONLY CRES PARTS ARE APPROVED.

TEMPERATURE LIMITS:

426°C (800°F)

MS35649
MS35650

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS35649-()	MS35649-()	MS35649-()
MS35650-()	MS35650-()	MS35650-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST DETAIL LISTING OF AVAILABLE STOCK.

MS35649	COARSE THREADS
-224	.0860-56-UNC-2B
-244	.1120-40-UNC-2B
-264	.1380-32-UNC-2B
-284	.1640-32-UNC-2B
MS356500	FINE THREADS
-304	.1900-32-UNF-2B
-3254	.2500-28-UNF-2B

APPLICABLE SPECIFICATIONS AND STANDARDS;

MIL-S-7742	MS35649
MIL-N-836	MS35650

SUPPLIER:

OPEN BID MAY INCLUDE

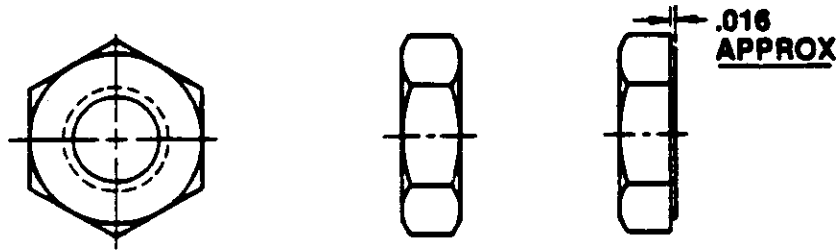
<u>MFR</u>	<u>CAGE</u>
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BURBANK AIR SUPPLY	5N982
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MS35649
MS35650

PREFERRED PART MS35691

NUT, PLAIN, HEXAGONAL, (JAM), UNF-2B, CRES



1. NUTS ARE 300 SERIES CRES IN ACCORDANCE WITH FF-N-836.
2. NUTS ARE PASSIVATED AS SPECIFIED IN ASTM A380.
3. NUTS UP TO 5/8-18 THREAD SIZE ARE NORMALLY SUPPLIED DOUBLE CHAMFERED. NUTS THAT ARE CHAMFERED ON ONE SIDE ONLY SHOULD BE ASSEMBLED WITH THE WASHER FACE DOWN AND THE CHAMFERED FACE UP.
4. NUTS SHALL HAVE A MAGNETIC PERMEABILITY OF 2.0 MAXIMUM (AIR = 1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

426°C (800°F)

MS35691-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS35691-()		MS35691-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE UNF-2B</u>	<u>DASH NUMBER</u>
5/16-24	15
3/8-24	23
7/16-20	31
1/2-20	39
9/16-18	47
5/8-18	55
3/4-16	63

1. FOR SMALLER SIZES, SEE MS35649-() AND MS35650-().

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-N-836 MS35691

SUPPLIERS:

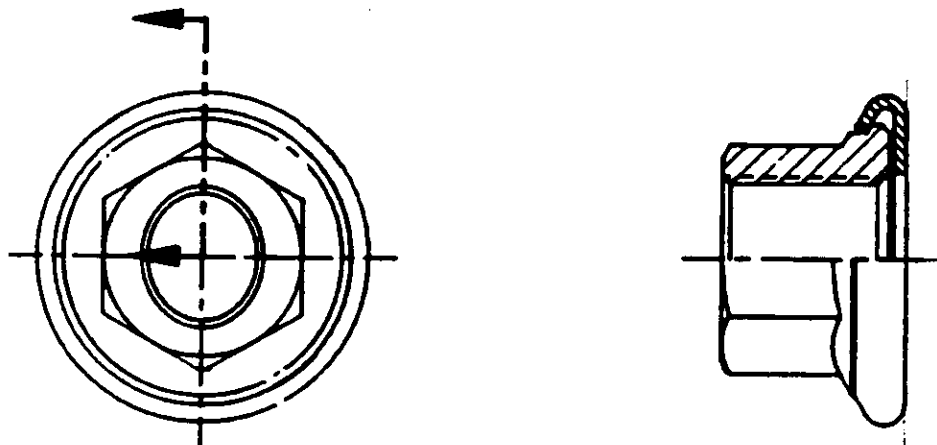
OPEN BID MAY INCLUDE

<u>MFR</u>	<u>CAGE</u>
BURBANK	
AIR SUPPLY	5N982
H. C. PACIFIC	53037

MS35691-()

PREFERRED PART ST10049

NUT, CAPTIVE WASHER, SELF-LOCKING, A-286 CRES



1. THESE NUTS WILL DEVELOP THE FULL RATED TENSILE STRENGTH OF 860 MPa (125,000 PSI) BOLTS AND SCREWS.
2. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
3. NUT SIZES .086 THRU .385 ARE AVAILABLE BUT NOT ALL SIZES ARE STOCKED.
4. ASSEMBLY-DISASSEMBLY LIMITED TO 5 CYCLES.
5. USE WITH CRES, 860 MPa (125,000 PSI), BOLTS, SCREWS, AND STUDS.
6. DRAWING CALLOUT: ST10049-(7).
7. DASH NUMBER INDICATES THREAD SIZE.
8. SEE ST10049 FOR COMPLETE DIMENSIONING.
9. SOLID FILM LUBRICANT MEETS MASS LOSS AND COLLECTED VOLATILE CONDENSABLE MATERIALS TESTS IN ACCORDANCE WITH ASTM-E-595 AND NASA SP-R-0022A.

TEMPERATURE LIMITS:

427°C (800°F)

ST10049

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10049-()		HW42-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST DETAIL LISTING OF AVAILABLE STOCK.

ST10049	COARSE THREADS
-1	.0860-56-UNJC-3B
-2	.1120-40-UNJC-3B
-3	.1380-32-UNJC-3B
-4	.1640-32-UNJC-3B
ST10049	FINE THREADS
-6	.1900-32-UNJF-3B
-8	.2500-28-UNJF-3B

APPLICABLE SPECIFICATIONS AND STANDARDS;

MIL-N-25027 ST10049
MIL-S-8879

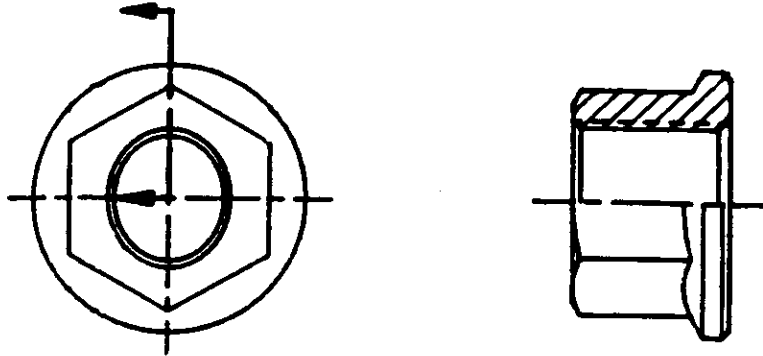
SUPPLIER:

MFR CAGE
KAYNAR 15653

ST10049

PREFERRED PART ST10060

NUT, HEXAGON, SELF-LOCKING, A-286 CRES



1. THESE NUTS WILL DEVELOP THE FULL RATED TENSILE STRENGTH OF 860 MPa (125,000 PSI) BOLTS AND SCREWS.
2. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
3. NUT AVAILABLE FOR BOLT AND SCREW DIAMETERS .086 THRU .375.
4. MAY BE USED WITH DS132, DS134, AND DS136.
5. ASSEMBLY-DISASSEMBLY LIMITED TO 15 CYCLES.
6. THREADS SILVER PLATED TO PREVENT GALLING.
7. DRAWING CALLOUT: SHOULD BE: ST10060-(8)
8. DASH NUMBER INDICATES THREAD SIZE.
9. SEE ST10060 FOR COMPLETE DIMENSIONING.

TEMPERATURE LIMITS:

427°C (800°F)

ST10060

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10060-()	MS21043-()	FN1014-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST DETAIL LISTING OF AVAILABLE STOCK.

ST10060	COARSE THREADS
-1	.0860-56-UNJC-3B
-2	.1120-40-UNJC-3B
-3	.1380-32-UNJC-3B
-4	.1640-32-UNJC-3B
ST10060	FINE THREADS
-5	.1900-32-UNJF-3B
-6	.2500-28-UNJF-3B
-7	.3120-24-UNJF-3B
-8	.3750-24-UNJF-3B

1. THESE NUTS MAY BE USED INSTEAD OF NAS679C(), NAS1291C(), AND MS21043-() NUTS WHERE THEY ARE CALLED OUT.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-N-25027
MIL-S-8879

MS21043
ST10060

NAS1291C()

SUPPLIER:

MFR

CAGE

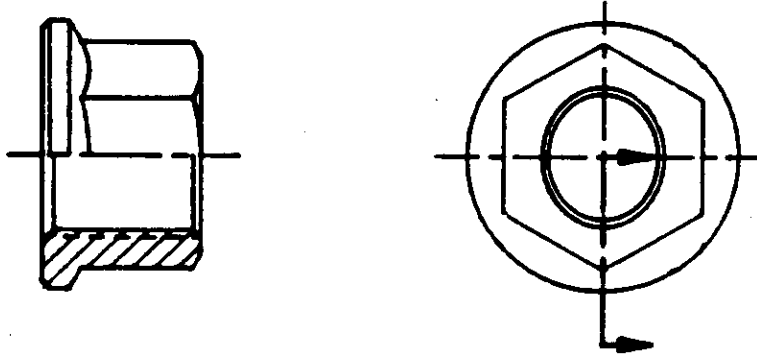
SPS

56878

ST10060

PREFERRED PART ST10061

NUT, HEXAGON, SELF-LOCKING, A-286 CRES, SOLID FILM LUBE COATED



1. THESE NUTS WILL DEVELOP THE FULL RATED TENSILE STRENGTH OF 760 MPa (110,000 PSI) WHEN USED ON 1100 MPa (160,000 PSI) BOLTS.
2. NUT AVAILABLE FOR BOLT AND SCREW DIAMETERS .086 THRU .375.
3. USE WITH TITANIUM BOLTS AND SCREWS.
4. ASSEMBLY-DISASSEMBLY LIMITED TO 2 CYCLES.
5. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. DRAWING CALLOUT: SHOULD BE: ST10061-(△7).
- △7. DASH NUMBER INDICATES THREAD SIZE.
8. SEE ST10061 FOR COMPLETE DIMENSIONING.

TEMPERATURE LIMITS:

204°C (400°F)

ST10061

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10061-Q	NAS1291CQM	63314M-Q

PREFERRED SIZES. SEE MASTER INVENTORY LIST DETAIL LISTING OF AVAILABLE STOCK.

ST10061	COARSE THREADS
-1	.0860-56-UNJC-3B
-2	.1120-40-UNJC-3B
-3	.1380-32-UNJC-3B
-4	.1640-32-UNJC-3B
ST10061	FINE THREADS
-5	.1900-32-UNJF-3B
-6	.2500-28-UNJF-3B
-7	.3120-24-UNJF-3B
-8	.3750-24-UNJF-3B

1. THESE NUTS MAY BE USED INSTEAD OF NAS679CQM AND NAS1291CQM NUTS WHERE THEY ARE CALLED OUT.

APPLICABLE SPECIFICATIONS AND STANDARDS;

MIL-N-25027	NAS1291CQM
MIL-S-8879	ST10061

SUPPLIER:

<u>MFR</u>	<u>CAGE</u>
SPS	56878

ST10061

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5.1.6 - Pins

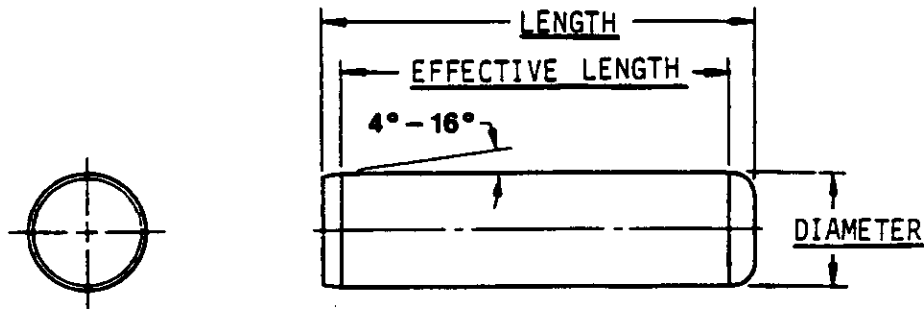
April 1993



JPL D-9984

PREFERRED PART MS16555

PIN, STRAIGHT, HEADLESS (DOWEL), STANDARD SERIES (.0002 OVER NOMINAL SIZE), CRES



1. MATERIAL TYPE 410 (UNS S41000) OR 416 (UNS S416000) HAVE A HARDNESS OF 36 TO 42 HRC.
2. PINS ARE CLEANED AND PASSIVATED IN ACCORDANCE WITH ASTM A380.
3. MARTENSITIC ~~STRUCTURE~~; MAY BECOME MAGNETIC.
4. ROUGHNESS AVERAGE (Ra) SHALL BE $Ra = 16\mu$ OR LESS IN ACCORDANCE WITH ANSI B46.1.
5. EFFECTIVE LENGTH OF ENGAGEMENT (SEE MS16555 DRAWING).

TEMPERATURE LIMITS:

216°C (400°F)

MS16555

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16555-()	MS16555-()	MS16555-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>NOM DIA.</u>	<u>LENGTHS</u>	<u>DASH NO.s</u>
.0625	.188 THRU .750	(601 THRU 608)
.0938	.312 THRU 1.000	(617 THRU 624)
.1250	.375 THRU 1.500	(625 THRU 633)
.1875	.500 THRU 1.500	(640 THRU 645)
.2500	.625 THRU 2.000	(646 THRU 652)
.3125	1.000 THRU 2.250	(653 THRU 659)
.375	1.500 THRU 3.000	(660 THRU 667)

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-P-21143 MS16555

SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
SPS	56878

MS16555

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5. 1 .7 - Retaining Rings

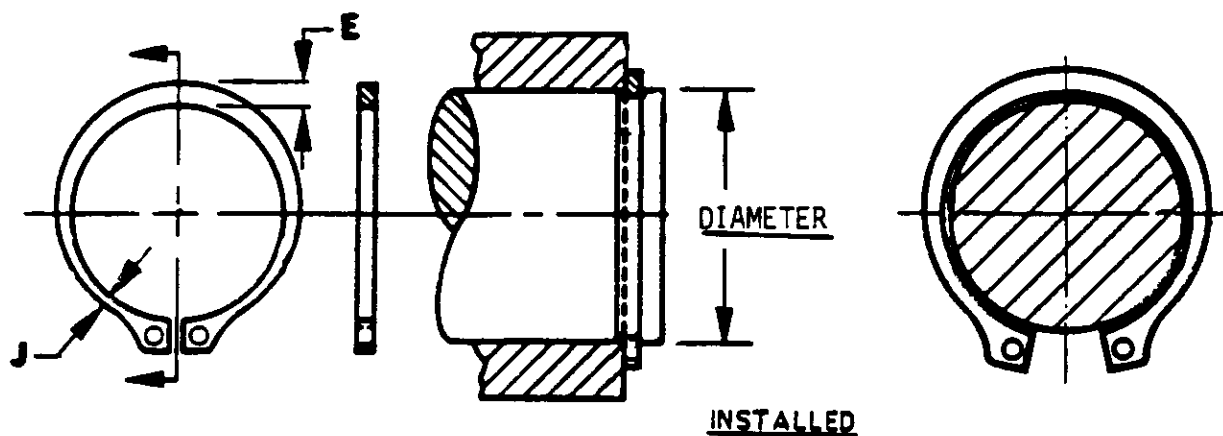
April 1993



JPL D-9984

PREFERRED PART MS16624-Q

RING, RETAINING, EXTERNAL, BASIC, CRES



1. CRES IS PH15-7MO (UNS S15700) CONFORMING TO AMS5520. PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. RINGS TAPER SYMMETRICALLY FROM "E" AT THE CENTER TO "J" AT THE FREE ENDS. AS A RESULT, RINGS REMAIN CIRCULAR WHEN EXPANDED WITHIN THE LIMITS OF NORMAL USE.
3. THESE RINGS ARE MAGNETIC WHEN SUBJECTED TO A MAGNETIC FIELD.
4. PART NUMBERS INDICATE THE SHAFT DIAMETER, NOT THE RING INSIDE DIAMETER.

TEMPERATURE LIMITS:

482°C (900°F)

MS16624-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16624-()	MS16624-()	5100-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>SHAFT DIAMETER</u>	<u>MS16624 DASH NO.</u>
.250	4025
.312	4031
.375	4037
.438	4043
.500	4050
.562	4056
.625	4062
.688	4068
.750	4075

1. SEE MS16555 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-R-21248

MS16624

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

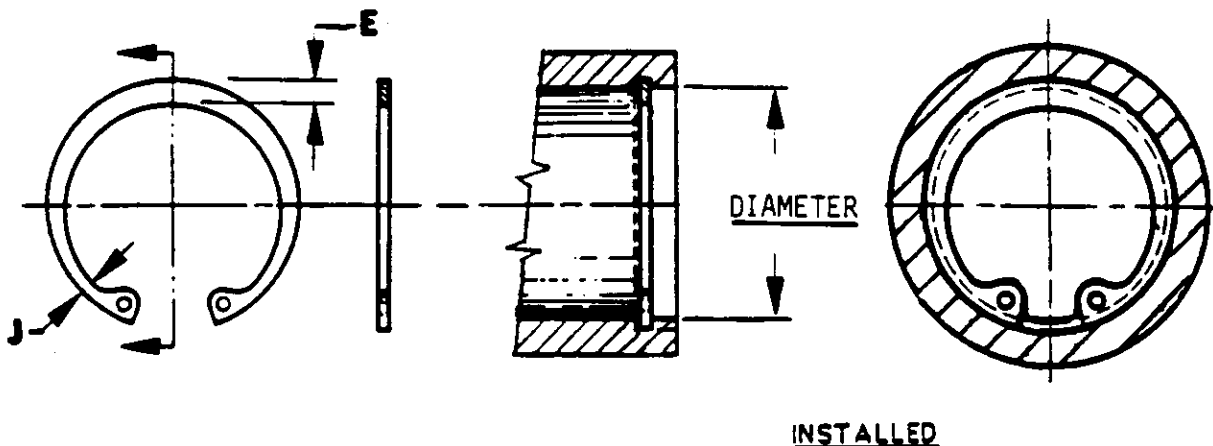
CAGE

IND RET
RING

MS16624-()

PREFERRED PART MS16625-Q

RING, RETAINING, INTERNAL, BASIC, CRES



1. CRES IS PH15-7MO (UNS S15700) CONFORMING TO AMS5520. PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. RINGS TAPER SYMMETRICALLY FROM "E" AT THE CENTER TO "J" AT THE FREE ENDS. AS A RESULT, RINGS REMAIN CIRCULAR WHEN CONTRACTED WITHIN THE LIMITS OF NORMAL USE.
3. THESE RINGS ARE MAGNETIC WHEN SUBJECTED TO A MAGNETIC FIELD.
4. PART NUMBERS INDICATE THE CYLINDER DIAMETER, NOT THE RING OUTSIDE DIAMETER.

TEMPERATURE LIMITS:

482°C (900°F)

MS16625-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16625-()	MS16625-()	5000-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>CYLINDER DIAMETER</u>	<u>MS16625 DASH NO.</u>
.500	4050
.562	4056
.625	4062
.688	4068
.750	4075
.812	4081
.875	4087
.938	4093
1.000	4100

1. SEE MS16555 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-R-21248

MS16625

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

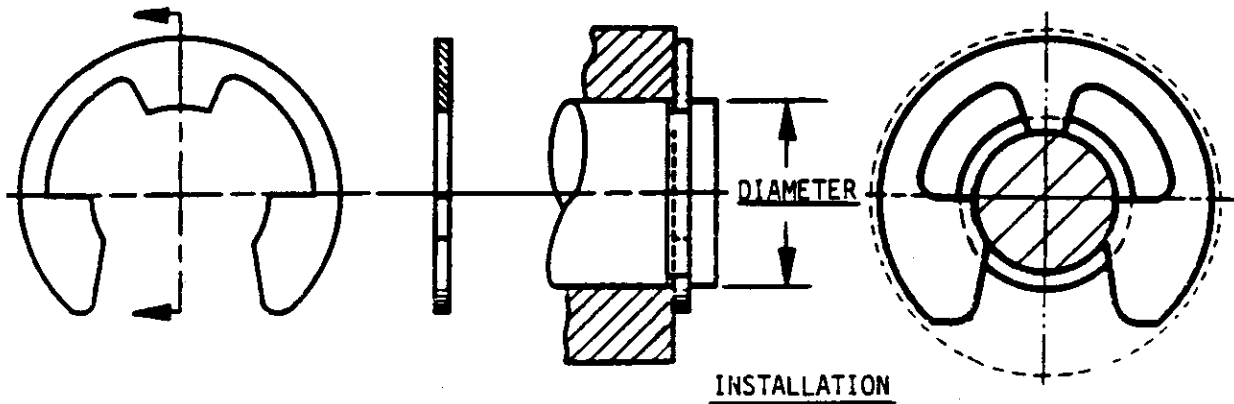
CAGE

IND RET
RING

MS16625-Q

PREFERRED PART MS16633-0

RING, RETAINING, EXTERNAL, E-RING, CRES



1. CRES IS PH15-7MO (UNS S15700) CONFORMING TO AMS5520.
PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. THESE RINGS ARE MAGNETIC WHEN SUBJECTED TO A MAGNETIC FIELD.
3. PART NUMBERS INDICATE THE SHAFT DIAMETER, NOT THE RING INSIDE DIAMETER.

TEMPERATURE LIMITS:

482°C (900°F)

MS16633-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16633-()	MS16633-()	5133-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>SHAFT DIAMETER</u>	<u>MS16633 DASH NO.</u>
.062	4006
.094	4009
.125	4012
.156	4015
.188	4018
.250	4025

1. SEE MS16555 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-R-21248

MS16633

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

CAGE

IND RET
RING

MS16633-()

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5.1.8 - Screws and Bolts

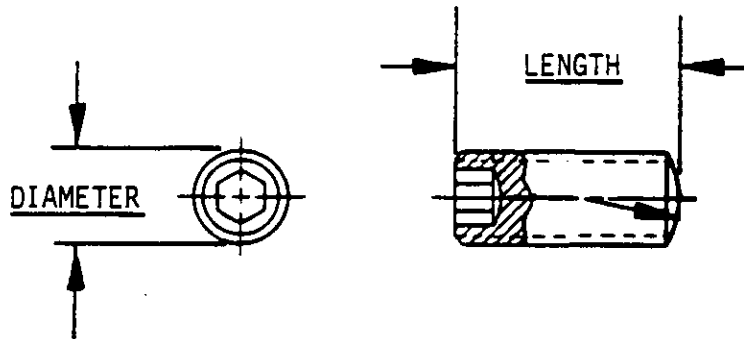
April 1993



JPL D-9984

PREFERRED PART AN565DC0H

SETSCREW-HEXAGON SOCKET, HEADLESS, CUP POINT, CRES



1. CRES MATERIAL CONFORMS TO MIL-S-7220, COMP. 303 OR 303SE (UNS30300 OR UNS30323) AND IS PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. USE OF SCREWS WITH LENGTHS SHORTER THAN THOSE LISTED ON PAGE 2 MAY RESULT IN HEXAGON TORQUE-OUT PROBLEMS DURING ASSEMBLY.
3. MAGNETIC PERMEABILITY LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

438°C (800°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

AN565DC0H

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
AN565(DC)H	AN565(DC)H	

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.-3A</u>	<u>LENGTHS</u>	<u>DASH NUMBERS</u>
.0860-56 UNC	(.1875 THRU .3125)	DC2H (3,4,5)
.1120-40 UNC	(.1875 THRU .625)	DC4H (3 THRU 10)
.1380-32 UNC	(.25 THRU .625)	DC6H (4 THRU 10)
.1640-32 UNC	(.25 THRU .75)	DC8H (4 THRU 12)
.1900-32 UNF	(.25 THRU .75)	DC1032H (4 THRU 12)
.2500-28 UNF	(.3125 THRU .875)	DC428H (5 THRU 14)

1. SEE AN565 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-200	AN565
MIL-S-7742	

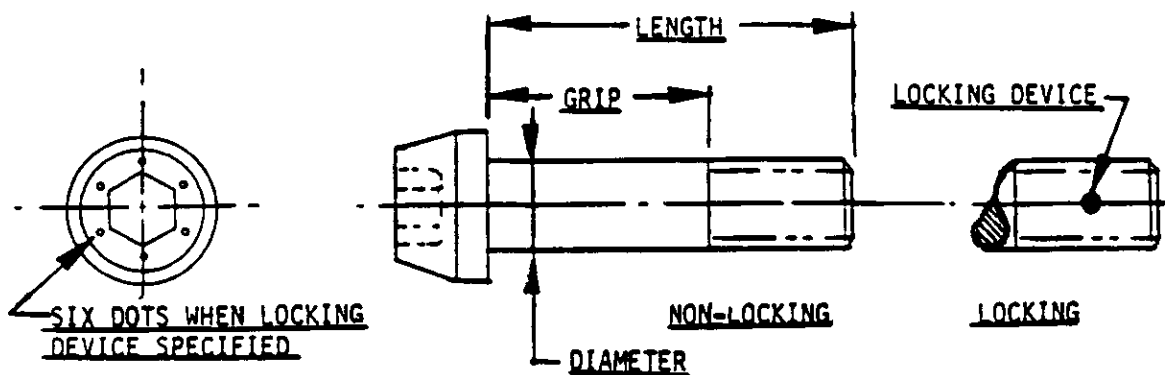
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
SPS	56878

AN565DC)H

PREFERRED PART DS83

SCREW, INTERNAL WRENCHING, CRES, SELF-LOCKING AND NON SELF-LOCKING



1. A-286 CRES PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. HEAT TREATED TO 1310 MPa (190,000 PSI) UTS MINIMUM.
3. WHEN SPECIFIED, THE LOCKING DEVICE IS A BURR FREE PLASTIC PELLET CONFORMING TO MIL-F-18240, TYPE N.
4. FOR FULLY THREADED SCREW, SEE DS132 (SAME STRENGTH LEVEL) OR MS16995 AND MS16996 (LOWER STRENGTH LEVEL).
5. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. SELF-LOCKING SCREWS HAVE DRY FILM LUBRICANT.
7. THREADS ARE 3A IN ACCORDANCE WITH MIL-S-8879.

TEMPERATURE LIMITS:

BOLT: 649°C (1200°F)
 LOCKING DEVICE: 121°C (250°F)

DS83

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
DS83-()-()		DS83-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>LENGTHS</u>	
02	(2 THRU 6)	(FULL THREAD LENGTH)
021	(3 THRU 6)	(FULL THREAD LENGTH)
04&04L	(1 THRU 8)	(GRIP LENGTH)
06&06L	(1 THRU 12)	(GRIP LENGTH)
08&08L	(1 THRU 16)	(GRIP LENGTH)
10&10L	(1 THRU 24)	(GRIP LENGTH)
1/4&1/4L	(2 THRU 24)	(GRIP LENGTH)
5/16&5/16L	(2 THRU 28)	(GRIP LENGTH)
3/8&3/8L	(3 THRU 32)	(GRIP LENGTH)
1/2&1/2L	(4 THRU 32)	(GRIP LENGTH)

1. LENGTHS ARE IN 1/16 INCREMENTS.
2. "L" FOLLOWING THE GRIP DASH NO. INDICATES SELF-LOCKING.
3. SEE DS83 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	DS83
MIL-F-18240	
CS-502726	

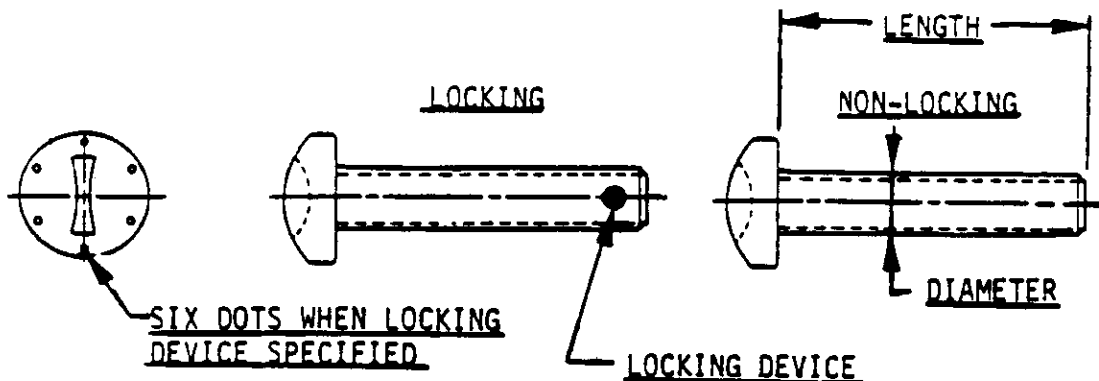
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
AIR INDUSTRIES	06725
HI-SHEAR	73197
SPS	56878
VOI SHAN	92215

DS83

PREFERRED PART DS132

SCREW, PAN HEAD, HI-TORQUE RECESS, FULL THREAD, LOCKING AND NON-LOCKING, CRES



1. HEAT TREATED TO 1310 MPa (190,000 PSI) UTS MINIMUM.
2. SCREWS MADE FROM A-286 CRES AND PASSIVATED IN ACCORDANCE WITH QQ-P-35.
3. WHEN SPECIFIED, THE LOCKING DEVICE IS A BURR FREE PLASTIC PELLET CONFORMING TO MIL-F-18240, TYPE N.
4. FOR GRIP TYPE SCREW, SEE DS133.
5. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. SELF-LOCKING SCREWS HAVE DRY FILM LUBRICANT.
7. THREADS ARE 3A IN ACCORDANCE WITH MIL-S-8879.

TEMPERATURE LIMITS:

SCREW: 649°C (1200°F) MAXIMUM
 LOCKING DEVICE: 121°C (250°F)

DS132

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
DS132-0-00		DS132-0-00

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>SCREW SIZE</u>	<u>GRIP LENGTHS</u>	<u>DS136 SECOND DASH NO.S</u>	
		<u>NON-LOCKING</u>	<u>SELF-LOCKING</u>
00	(.125 THRU .250)	(2 THRU 4)	(3 THRU 4)L
02	(.125 THRU .375)	(2 THRU 6)	(3 THRU 6)L
04	(.188 THRU .500)	(3 THRU 8)	(4 THRU 8)L
06	(.188 THRU .750)	(3 THRU 12)	(4 THRU 12)L
08	(.188 THRU 1.000)	(3 THRU 16)	(4 THRU 16)L
10	(.188 THRU 1.500)	(3 THRU 24)	(6 THRU 24)L
25	(.250 THRU 2.000)	(4 THRU 32)	(6 THRU 32)L

1. SELF-LOCKING SCREWS HAVE A MINIMUM LENGTH REQUIREMENT FOR PELLET INSTALLATION; THEREFORE, FEWER LENGTHS OF SELF-LOCKING SCREWS ARE GIVEN. THE DASH NUMBER IS THE LENGTH IN 1/16THS.
2. LENGTHS ARE AVAILABLE IN 1/16TH INCREMENTS UP TO 1.000 AND 1/8TH INCREMENTS FROM 1.000 THRU 2.000.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	DS132
MIL-F-18240	
CS-502726	

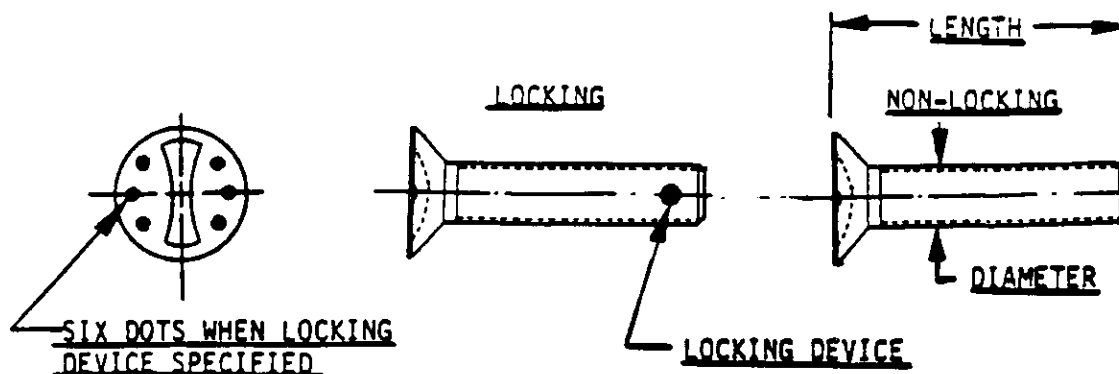
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
AIR INDUSTRIES	06725
HI-SHEAR	73197
SPS	56878
VOI SHAN	92215

DS132

PREFERRED PART DS134

SCREW, CSK HEAD, HI-TORQUE RECESS, FULL THREAD, LOCKING AND NON-LOCKING, CRES



1. HEAT TREATED TO 1100 MPa (160,000 PSI) UTS MINIMUM.
2. SCREWS MADE FROM A-286 CRES AND PASSIVATED IN ACCORDANCE WITH QQ-P-35.
3. WHEN SPECIFIED, THE LOCKING DEVICE IS A BURR FREE PLASTIC PELLET CONFORMING TO MIL-F-18240, TYPE N.
4. FOR GRIP TYPE SCREW, SEE NAS1580.
5. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. SELF-LOCKING SCREWS HAVE DRY FILM LUBRICANT.
7. THREADS ARE 3A IN ACCORDANCE WITH MIL-S-8879.

TEMPERATURE LIMITS:

SCREW: 649°C (1200°F) MAXIMUM
LOCKING DEVICE: 121°C (250°F)

DS134

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
DS134-()-()		DS134-()-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

SCREW SIZE	GRIP LENGTHS	DS136 SECOND DASH NO.S	
		<u>NON-LOCKING</u>	<u>SELF-LOCKING</u>
00	(.125 THRU .250)	(2 THRU 6)	(4 THRU 6)L
02	(.188 THRU .375)	(3 THRU 6)	(4 THRU 6)L
04	(.250 THRU .500)	(4 THRU 8)	(4 THRU 8)L
06	(.250 THRU .750)	(4 THRU 12)	(5 THRU 12)L
08	(.312 THRU 1.000)	(5 THRU 16)	(6 THRU 16)L
10	(.312 THRU 1.500)	(5 THRU 24)	(8 THRU 24)L
25	(.375 THRU 2.000)	(6 THRU 32)	(8 THRU 32)L

1. SELF-LOCKING SCREWS HAVE A MINIMUM LENGTH REQUIREMENT FOR PELLET INSTALLATION; THEREFORE, FEWER LENGTHS OF SELF-LOCKING SCREWS ARE GIVEN. THE DASH NUMBER IS THE LENGTH IN 1/16 THS.
2. LENGTHS ARE AVAILABLE IN 1/16TH INCREMENTS UP TO 1.000 AND 1/8TH INCREMENTS FROM 1.000 THRU 2.000.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	DS134
MIL-F-18240	
CS-502726	

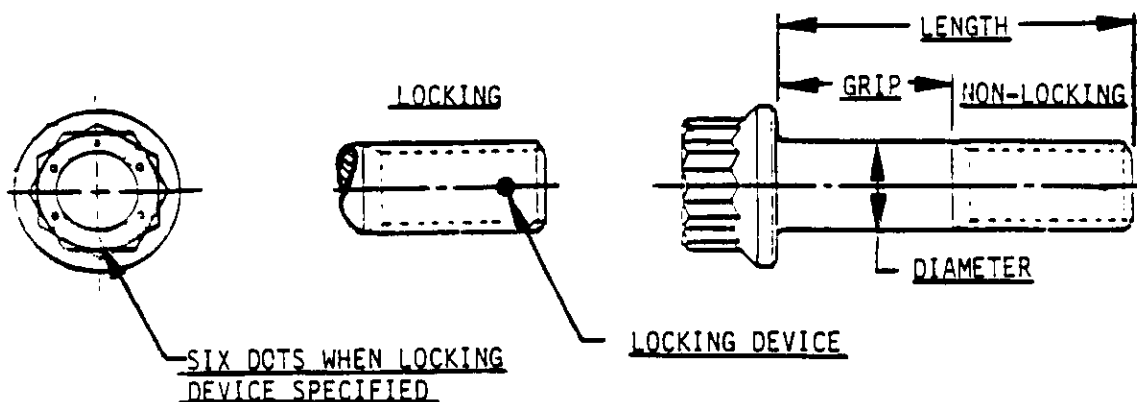
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
AIR INDUSTRIES	06725
HI-SHEAR	73197
SPS	56878
VOI SHAN	92215

DS134

PREFERRED PART DS136

SCREW, CLOSE TOLERANCE, 12 POINT, EXTERNAL WRENCHING, A-286, SELF-LOCKING AND NON-SELF-LOCKING.



1. HEAT TREATED TO 1310 MPa (190,000 PSI) UTS MINIMUM.
2. CLOSE TOLERANCE BOLT MADE FROM A-286 CRES AND PASSIVATED IN ACCORDANCE WITH JPL SPECIFICATION FS505146.
3. WHEN SPECIFIED, THE LOCKING DEVICE IS A BURR FREE PLASTIC PELLET CONFORMING TO MIL-F-18240, TYPE N.
4. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
5. SELF-LOCKING SCREWS HAVE DRY FILM LUBRICANT.
6. THREADS ARE 3A IN ACCORDANCE WITH MIL-S-8879.

TEMPERATURE LIMITS:

SCREW: 649°C (1200°F) MAXIMUM
 LOCKING DEVICE: 121°C (250°F)

DS136

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
DS136-0-00		DS136-0-00

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>SCREW SIZE</u>	<u>GRIP LENGTHS</u>	<u>DS136 SECOND DASH NO.S</u>	
		<u>NON-LOCKING</u>	<u>SELF-LOCKING</u>
06	(.062 THRU .750)	(1 THRU 12)	(1 THRU 12)L
08	(.062 THRU 1.000)	(1 THRU 16)	(1 THRU 16)L
10	(.062 THRU 1.500)	(1 THRU 24)	(1 THRU 24)L
25	(.062 THRU 1.500)	(1 THRU 24)	(1 THRU 24)L
31	(.062 THRU 2.000)	(1 THRU 32)	(1 THRU 32)L
50	(.062 THRU 2.000)	(1 THRU 32)	(1 THRU 32)L

1. GRIP LENGTHS ARE IN 1/16 INCH INCREMENTS.
2. "L" FOLLOWING GRIP LENGTH DASH NO.s INDICATES SELF-LOCKING.
3. SEE DS136 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	DS136
MIL-F-18240	
CS-502726	

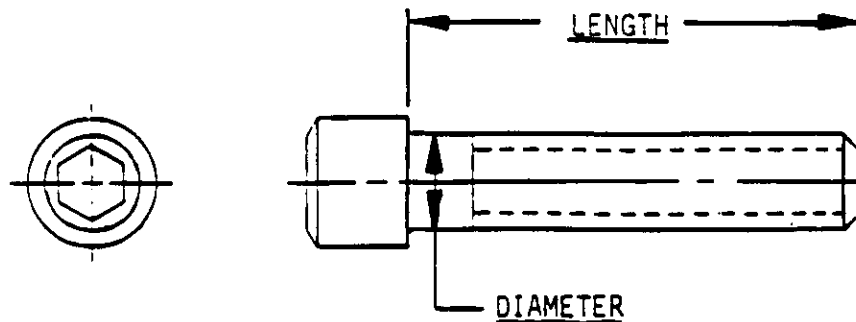
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
AIR INDUSTRIES	06725
HI-SHEAR	73197
SPS	56878
VOI SHAN	92215

DS136

PREFERRED PART MS16995-0

SCREW, CAP, SOCKET HEAD-HEXAGON, CRES, UNC-3A



1. SCREW MATERIAL IS 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. TENSILE STRENGTH IS 550 MPa (80,000 PSI) UTS BASED ON MIL-HDBK-28 STRESS AREAS.
3. MAGNETIC PERMEABILITY IS LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

427°C (800°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

MS16995-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16995-()	MS16995-()	MS16995-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>LENGTHS</u>	<u>DASH NUMBERS</u>
.0860-56	.188 THRU .500	1 THRU 4
.1120-40	.250 THRU .750	9 THRU 13
.1380-32	.250 THRU .750	16 THRU 20
.1640-32	.375 THRU .875	25 THRU 29

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-86

SUPPLIERS:

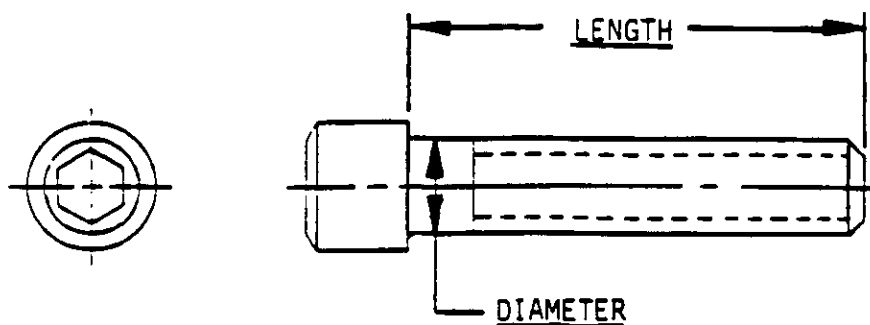
OPEN BID MAY INCLUDE

<u>MFR</u>	<u>CAGE</u>
BURBANK AIR SUPPLY	5N982
H.C. PACIFIC	53037

MS16995-()

PREFERRED PART MS16996-0

SCREW, CAP, SOCKET HEAD-HEXAGON, CRES, UNF-3A



1. SCREW MATERIAL IS 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. TENSILE STRENGTH IS 550 MPa (80,000 PSI) UTS BASED ON MIL-HDBK-28 STRESS AREAS.
3. MAGNETIC PERMEABILITY IS LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

427°C (800°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

MS16996-0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS16996-()	MS16996-()	MS16996-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>LENGTHS</u>	<u>DASH NUMBERS</u>
.0600-80	.125 THRU .375	81 THRU 84
.1900-32	.375 THRU .875	40 THRU 44
.2500-28	.500 THRU 1.000	50 THRU 53
.3750-24	.625 THRU 1.250	70 THRU 72

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-86

SUPPLIERS:

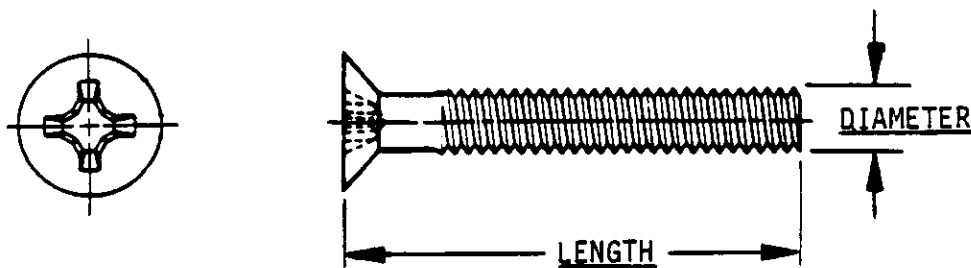
OPEN BID MAY INCLUDE

<u>MFR</u>	<u>CAGE</u>
BURBANK AIR SUPPLY	5N982
H.C. PACIFIC	53037

MS16996-()

PREFERRED PART MS24693C0

SCREW, MACHINE, 100° C'SUNK HEAD, CROSS RECESSED, FULL THREAD, CRES.



1. SCREWS ARE MADE FROM 300 SERIES CRES CONFORMING TO FED-STD-66, COMPOSITION 302 (UNS S30200), 303 (UNS S30300), 304 (UNS S30400), 305 (UNS S30500) OR 316 (UNS S31600).
2. SCREWS ARE CLEANED AND PASSIVATED IN ACCORDANCE WITH ASTM A380.
3. THESE SCREWS HAVE AN ULTIMATE TENSILE STRENGTH OF 550 MPa (80,000 PSI) BASED ON FED-STD-H28 STRESS AREAS.
4. THESE HAVE A LOW MAGNETIC PERMEABILITY IN ACCORDANCE WITH PROCUREMENT SPECIFICATION FF-S-92.

TEMPERATURE LIMITS:

427°C (800°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

MS24693C90

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS24693C()	MS24693C()	MS24693C()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>PREFERRED LENGTHS</u>	<u>MS24693C DASH NUMBERS</u>
.1120-40 UNC-2A	(.188 THRU .500)	(1 THRU 6)
.1380-32 UNC-2A	(.188 THRU .750)	(23 THRU 30)
.1640-32 UNC-2A	(.250 THRU 1.000)	(46 THRU 54)
.1900-32 UNF-2A	(.250 THRU 1.500)	(268 THRU 280)

1. LENGTHS THRU .500 INCREASE BY 1/16 INCREMENTS, OVER .500 THRU 2.000 INCREASE BY 1/8 INCREMENTS.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-97	MS24693C
MIL-S-7742	

SUPPLIERS:

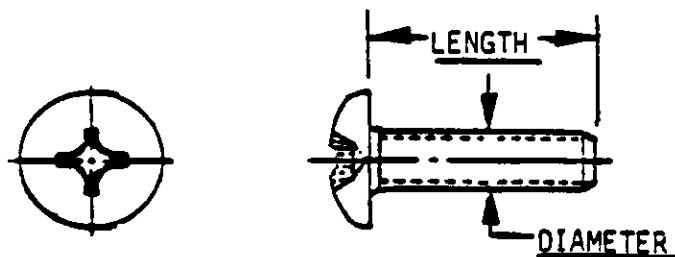
OPEN BID MAY INCLUDE

<u>MFR</u>	<u>CAGE</u>
BURBANK AIR SUPPLY	5N982
H.C. PACIFIC	53037

MS24693C()

PREFERRED PART MS51957

SCREW, MACHINE-PAN HEAD, CRES, UNC-2A



1. STRENGTH LEVEL APPROXIMATELY 550 MPa (80,000 PSI).
2. MATERIAL 300 SERIES CRES.
3. PASSIVATED IN ACCORDANCE WITH ASTM A380.
4. SCREWS SHALL HAVE COMPLETE (FULL THREAD FORM) THREADS TO WITHIN TWO THREAD PITCHES OF THE HEAD.
5. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. USE WITH LOCKING AND NON-LOCKING NUTS. SEE ST10072 FOR SELF-LOCKING VERSION.

TEMPERATURE LIMITS:

427°C (800°F) MAXIMUM

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

MS51957

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS51957-0	MS51957-0	MS51957-0

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>PREFERRED LENGTHS</u>	<u>MS24693C DASH NUMBERS</u>
.0860-56	(.125 THRU .500)	(1 THRU 7)
.1120-40	(.125 THRU .500)	(11 THRU 17)
.1380-32	(.188 THRU .750)	(25 THRU 32)
.1640-32	(.250 THRU 1.000)	(42 THRU 49)

1. LENGTHS INCREASE BY 1/16TH FROM .125 THRU .500 INCHES, 1/8TH THRU 1.000 INCH, AND 1/4TH THEREAFTER.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-92

MS51957

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

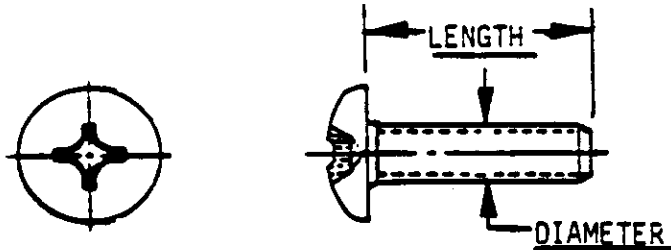
CAGE

BURBANK AIR SUPPLY	5N982
H.C. PACIFIC	53037

MS51957

PREFERRED PART MS51958

SCREW, MACHINE-PAN HEAD, CRES, UNF-2A



1. STRENGTH LEVEL APPROXIMATELY 550 MPa (80,000 PSI).
2. MATERIAL 300 SERIES CRES.
3. PASSIVATED IN ACCORDANCE WITH ASTM A380.
4. SCREWS SHALL HAVE COMPLETE (FULL THREAD FORM) THREADS TO WITHIN TWO THREAD PITCHES OF THE HEAD.
5. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. USE WITH LOCKING AND NON-LOCKING NUTS. SEE ST10072 FOR SELF-LOCKING VERSION.

TEMPERATURE LIMITS:

427°C (800°F) MAXIMUM

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

MS51958

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS51958-()	MS51958-()	MS51958-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>PREFERRED LENGTHS</u>	<u>MS51958 DASH NUMBERS</u>
.1900-32	(.250 THRU 1.500)	(59 THRU 69)
.2500-28	(.312 THRU 2.000)	(76 THRU 87)

1. LENGTHS INCREASE BY 1/16TH FROM .125 THRU .500 INCHES, 1/8TH THRU 1.000 INCH, AND 1/4TH THEREAFTER.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-92

MS51958

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

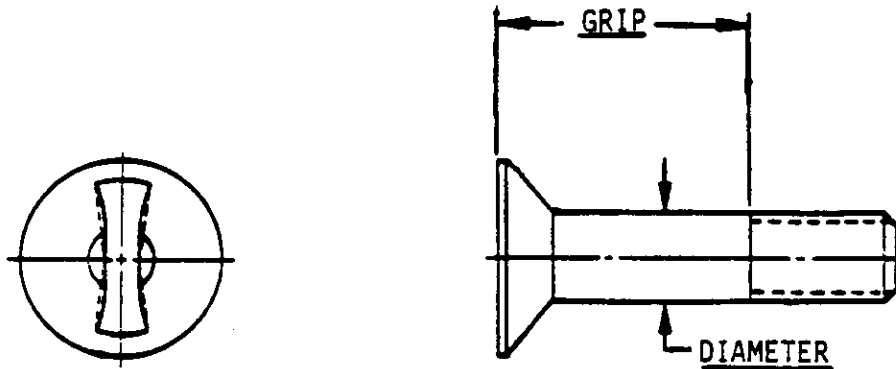
CAGE

BURBANK AIR SUPPLY	5N982
H.C. PACIFIC	53037

MS51958

PREFERRED PART NAS1580C3H0

BOLT, 100° FLUSH HEAD, HI-TORQUE RECESS, NON SELF-LOCKING, CRES



1. HEAT TREATED TO 1100 MPa (160,000 PSI) UTS MINIMUM BASED ON NAS 1348 STRESS AREA.
2. MATERIAL A-286 CRES(UNS S66286) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
3. FOR FULL THREAD PART, SEE DS134.
4. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

649°C (1200°F)

NAS1580C3H0

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
NAS1580C3H()		NAS1580C3H()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>DIA.</u>	<u>GRIP</u>	<u>DASH NO.</u>
.1900 UNJF-3A	(.188 THRU 1.250)	(3 THRU 20)

1. GRIP LENGTHS ARE 1/16 INCREMENTS.
2. SEE NAS1580 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-8879	NAS1580
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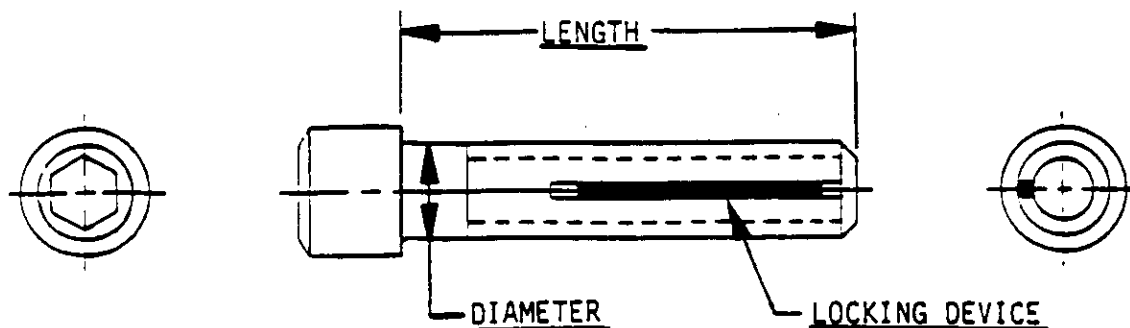
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
AIR INDUSTRIES	06725
HI-SHEAR	73197
SPS	56878
VOI SHAN	92215

NAS1580C3H()

PREFERRED PART ST10051-Q

SCREW, SOCKET HEAD, HEXAGON, LOCKING, CRES



1. SCREW MATERIAL IS 303 CRES (UNS S30300) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. LOCKING ELEMENT CONFORMS TO NAS1282, TYPE L, KEL-F.
3. MAGNETIC PERMEABILITY SHALL BE LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
4. TENSILE STRENGTH IS APPROXIMATELY 550 MPa (80,000 PSI) UTS BASED ON MIL-HDBK-28 STRESS AREAS.

TEMPERATURE LIMITS:

CRES: 427°C (800°F)
KEL-F: 149°C (300°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

ST10051-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10051-(1 THRU 30)		MS16995-()MHQ
ST10051-(40 THRU 84)		MS16996-()MHQ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>SOLID FILM LUBED</u>	<u>SILVER PLATED</u>
.0600-80 UNF-2A	.125 THRU .375	81 THRU 84
.0860-56 UNC-2A	.188 THRU .500	1 THRU 4
.1120-40 UNC-2A	.250 THRU .750	9 THRU 13
.1380-32 UNC-2A	.250 THRU .750	16 THRU 20
.1640-32 UNC-2A	.375 THRU .875	25 THRU 29
.1900-32 UNF-2A	.375 THRU .875	40 THRU 44
.2500-28 UNF-2A	.500 THRU 1.000	50 THRU 53
.3750-24 UNF-2A	.625 THRU 1.250	70 THRU 72

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-S-86

NAS1283

SUPPLIERS:

MFR

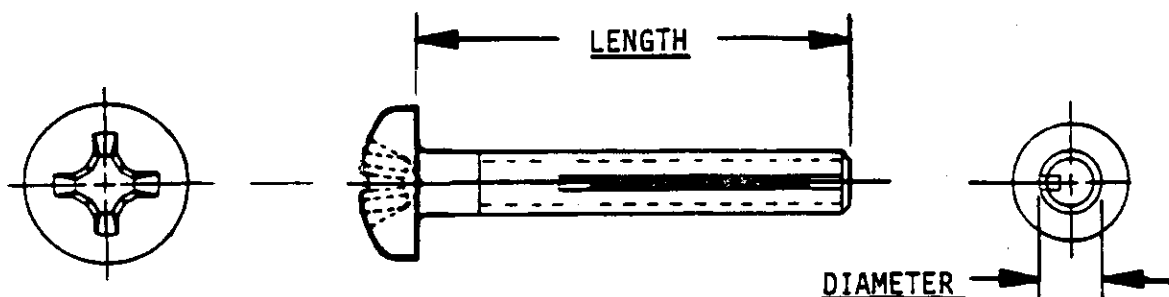
CAGE

LONG-LOK CORP. 03038

ST10051-Q

PREFERRED PART ST10072-Q

SCREW, PAN HEAD, CROSS RECESS, SELF-LOCKING, CRES



1. ULTIMATE TENSILE STRENGTH APPROXIMATELY 550 MPa (80,000 PSI) BASED ON FED-STD-H28 STRESS AREAS.
2. SCREW IS MADE FROM 300 SERIES CRES AND PASSIVATED IN ACCORDANCE WITH ASTM A380.
3. LOCKING DEVICE CONFORMS TO NAS1238 TYPE L.
4. SCREWS SHALL HAVE COMPLETE (FULL THREAD FORM) THREADS TO WITHIN TWO THREAD PITCHES OF THE HEAD.
5. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
6. USE WITH NON-LOCKING NUTS.

TEMPERATURE LIMITS:

LOCKING DEVICE: 121°C (250°F)
SCREW: 427°C (800°F)

NOTE

The fasteners shown on this page are not considered structural fasteners regardless of size and must be chosen with great care when used in load carrying applications.

ST10072-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10072-(13 THRU 49)		MS51957-(3 THRU 49) MHQ
ST10072-(63 THRU 87)		MS51958-(62 THRU 87) MHQ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE</u>	<u>LENGTHS PREFERRED</u>	<u>ST10072 DASH NUMBER</u>
.0860-56 UNC-2A	(.250 THRU .500)	(3 THRU 7)
.1120-40 UNC-2A	(.312 THRU .500)	(14 THRU 17)
.1380-32 UNC-2A	(.375 THRU .750)	(28 THRU 32)
.1640-32 UNC-2A	(.438 THRU 1.000)	(44 THRU 49)
.1900-32 UNF-2A	(.438 THRU 1.500)	(62 THRU 69)
.2500-28 UNF-2A	(.500 THRU 2.000)	(79 THRU 87)

1. LENGTH INCREMENTS ARE 1/16 FROM .188 THRU .500, AND 1/8 ABOVE .500 THRU 1.000 AND 1/4 ABOVE 1.000.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-7742	ST10072
FF-S-92	NAS 1238

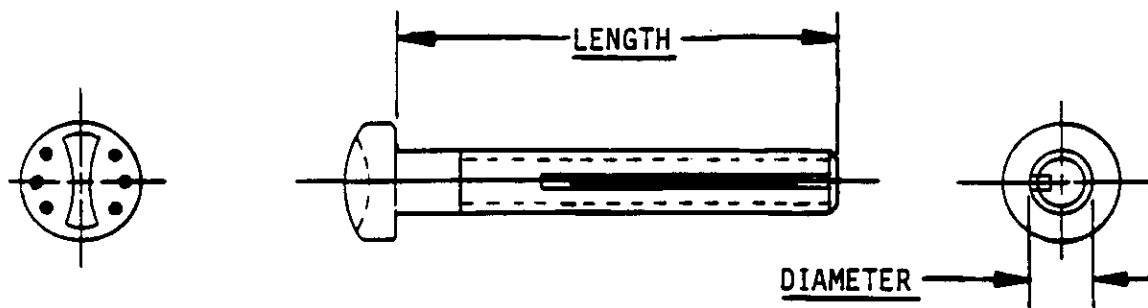
SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
LONG-LOK CORP.	03038

ST10072-Q

PREFERRED PART ST10073-Q

SCREW, PAN HEAD, FULL THREAD, HI-TORQUE RECESS, LOCKING, CRES



1. MATERIAL IS A-286 CRES (UNS S66286) PASSIVATED IN ACCORDANCE WITH QQ-P-35.
2. LOCKING ELEMENT IS KEL-F CONFORMING TO NAS1283, TYPE L.
3. MINIMUM TENSILE STRENGTH 1100 MPa (160,000 PSI) UTS BASED ON NAS1348 STRESS AREAS.
4. FOR NON-SELF-LOCKING SCREW, SEE DS132.
5. MAGNETIC PERMEABILITY SHALL BE A MAXIMUM OF 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.

TEMPERATURE LIMITS:

LOCKING DEVICE: 121°C (250°F)
SCREW: 649°C (1200°F)

ST10073-Q

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
ST10073-Q		LL1216-QE-QMHQ

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

<u>THREAD SIZE-3A</u>	<u>LENGTHS PREFERRED</u>	<u>ST10073 DASH NUMBER</u>
.1120-40 UNJC	(.312 THRU .500)	(4 THRU 7)
.1380-32 UNJC	(.438 THRU .750)	(16 THRU 19)
.1640-32 UNJC	(.438 THRU .875)	(29 THRU 33)
.1900-32 UNJF	(.500 THRU 1.000)	(45 THRU 49)
.2500-28 UNJF	(.625 THRU 1.500)	(65 THRU 70)
.3125-24 UNJF	(.625 THRU 2.250)	(80 THRU 88)
.3750-24 UNJF	(.625 THRU 2.500)	(95 THRU 104)

1. LENGTH INCREMENTS TO .50 INCH ARE 1/16TH, 1/8TH FROM .50 THRU 1.0 INCH AND 1/4TH THEREAFTER.

APPLICABLE SPECIFICATIONS AND STANDARDS:

MIL-S-7742	ST10073
MIL-S-8879	NAS 1238

SUPPLIERS:

<u>MFR</u>	<u>CAGE</u>
LONG-LOK CORP.	03038

ST10073-Q

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Illustrated Preferred Fastener List Section 5.1.9 - Washers

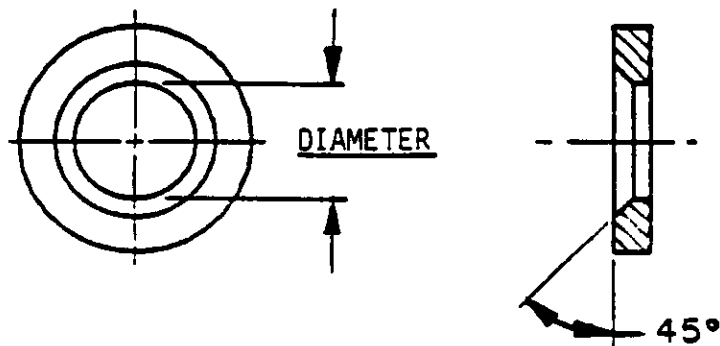
April 1993



JPL D-9984

PREFERRED PART 90273-00

WASHER, COUNTERSUNK, ALUMINUM ALLOY AND CRES



1. AN "F" AFTER THE DASH NUMBER INDICATES CRES 303 (UNS S30300) OR 304 (S30400).
2. A "C" AFTER THE DASH NUMBER INDICATES ALUMINUM ALLOY 6061-T6 (UNS A96061).
3. USE THESE WASHERS UNDER THE HEADS OF BOLTS AND SCREWS TO PREVENT THE BOLT AND SCREW FILLETS COMING INTO CONTACT WITH THE SHARP EDGE OF HOLES.
4. CRES IS PASSIVATED IN ACCORDANCE WITH JPL SPECIFICATION FS505146.
5. ALUMINUM ALLOY IS ANODIZED IN ACCORDANCE WITH MIL-A-8625, TYPE III, CLASS 2.

TEMPERATURE LIMITS:

6061: 93°C (200°F)
303 & 304: 427°C (800°F)

90273-00

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
90273-QC		90273-QC
90273-QF		90273-QF

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

BOLT SIZE REF	APPROVED DASH NUMBERS	
	<u>CRES</u>	<u>ALUMINUM</u>
04	4F	4C
06	5F	5C
08	6F	6C
10	(7, 23)F	7C
1/4	(8, 26, 27)F	8C
5/16	(9, 30)F	9C
3/8	10F	28C

1. JPL (CAGE 23835) DRAWING 90273.

APPLICABLE SPECIFICATIONS AND STANDARDS:

90273

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

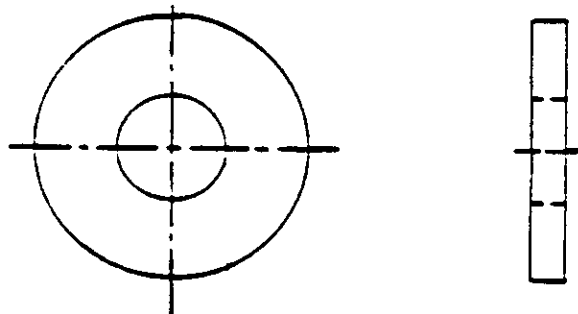
CAGE

CAL SWISS

90273-Q0

PREFERRED PART AN960C

WASHER, FLAT, CRES



1. CORROSION RESISTANT STEEL IN ACCORDANCE WITH MIL-S-5049, AMS5510, OR AMS5512.
2. PASSIVATED IN ACCORDANCE WITH QQ-P-35.
3. FOR ALUMINUM WASHERS, SEE MS15795.

TEMPERATURE LIMITS:

CRES: 649°C (1200°F)

AN960C

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
AN960C()	AN960C()	AN960C()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

C(3, 4, 6, 10, 416, 516, 616, 716)L
C(3, 4, 6, 10, 416, 516, 616, 716)

1. THE NUMBER IN () INDICATES SCREW DIAMETER.
2. "L" INDICATES REDUCED THICKNESS.
3. USE C3L AND C3 DIAMETERS WITH 2-56 SCREWS.
4. SEE AN960 FOR COMPLETE DIMENSIONING.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-W-92

AN960

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR

CAGE

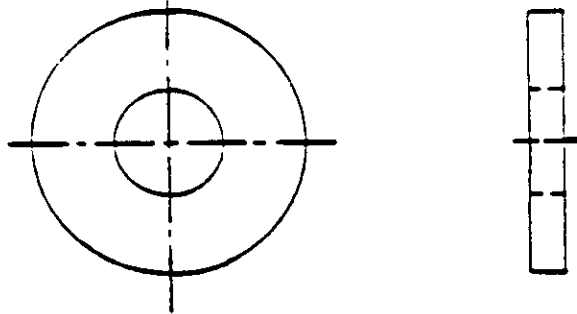
ANILLO
BURBANK
AIR SUPPLY

5N982

AN960C

PREFERRED PART MS15795

WASHER, FLAT, GENERAL PURPOSE, ALUMINUM AND CRES



1. CRES 300 SERIES IN ACCORDANCE WITH FF-W-92.
2. CRES SHALL BE PASSIVATED IN ACCORDANCE WITH ASTM A380.
3. ALUMINUM ALLOY ANODIZED IN ACCORDANCE WITH MIL-A-8625, TYPE I OR II, CLASS 1.
4. MAGNETIC PERMEABILITY IS LESS THAN 2.0 (AIR=1.0) FOR A FIELD STRENGTH OF 200 OERSTEDS.
5. PREFERRED SIZES SELECTED FROM ANSI/ASME B18.22.1 TYPE A WASHERS.

TEMPERATURE LIMITS:

CRES: 649°C (1200°F)
ALUMINUM: 121°C (250°F)

MS15795

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
MS15795-()	MS15795-()	MS15795-()

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

INSIDE DIAMETERS, .078 THRU .500

CRES DASH NUMBERS: $\triangle 1$

(801, 844, 802, 803, 805, 806, 807, 841, 808, 842, 809, 852, 810 THRU 817)

ALUMINUM DASH NUMBERS: $\triangle 1$

(701, 702, 703, 705, 706, 707, 741, 708, 742, 709, THRU 717)

$\triangle 1.$

DASH NUMBERS GIVEN IN ORDER OF INCREASING ID.

APPLICABLE SPECIFICATIONS AND STANDARDS:

FF-W-92 MS15795
ANSI/ASME B18.22.1

SUPPLIERS:

OPEN BID MAY INCLUDE

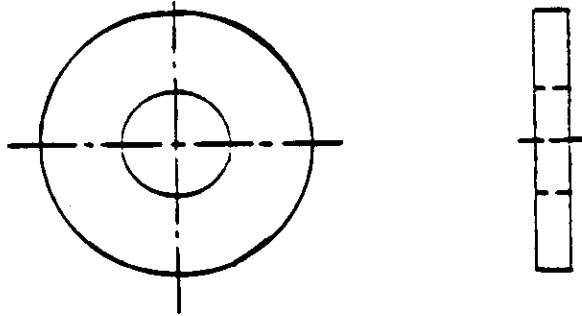
MFR CAGE

ANILLO
BURBANK 5N982
AIR SUPPLY

MS15795

PREFERRED PART NAS620

WASHER, FLAT, REDUCED OUTSIDE DIAMETER, ALUMINUM AND CRES



1. ALUMINUM ALLOY, 5052-H32 OR 5052-H34. NO FINISH.
2. CRES 300 SERIES IN ACCORDANCE WITH QQ-S-766, CONDITION A.
3. CRES SHALL BE PASSIVATED IN ACCORDANCE WITH QQ-P-35.
4. USE WHERE REDUCED OUTSIDE DIAMETER IS NECESSARY.
5. USE AN960 AND MS15795 WASHERS WHEREVER PRACTICAL.

TEMPERATURE LIMITS:

CRES: 649°C (1200°F)
ALUMINUM: 94°C (200°F)

NAS620

EQUIVALENT PART NUMBER SERIES		
JPL	GOVERNMENT	SUPPLIER
NAS62000	NAS62000	NAS62000

PREFERRED SIZES. SEE MASTER INVENTORY LIST FOR DETAIL LISTING OF AVAILABLE STOCK.

ALUMINUM DASH NUMBERS: $\triangle 1$

A(4, 6, 8, 10, 416)
A(4, 6, 8, 10, 416)L

CRES DASH NUMBERS: $\triangle 1$

C(4, 6, 8, 10, 416)
C(4, 6, 8, 10, 416)L

$\triangle 1.$ NUMBER IN Q INDICATES SCREW SIZE.

2. SEE NAS620 FOR COMPLETE DIMENSIONING AND APPROPRIATE DASH NUMBERS.

APPLICABLE SPECIFICATIONS AND STANDARDS:

NAS620

SUPPLIERS:

OPEN BID MAY INCLUDE

MFR CAGE

ANILLO
BURBANK 5N982
AIR SUPPLY

NAS620

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 6.0 - Packaging and Cabling Hardware


April 1993





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Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

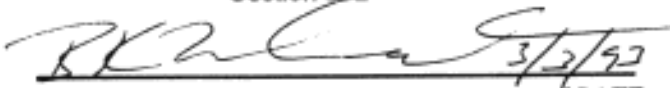
Section 6.0 – Packaging and Cabling Hardware

 3/3/93
Approved by: J. W. Billitti DATE
Group Supervisor
Cabling Engineering Group
Mechanical Systems Development
Section 352

 3/3/93
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Approved by: T. P. O'Donnell DATE
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Released by: J. W. Anderson DATE
Technical Editor
Documentation
Section 648

 3/2/93
Approved by: B. K. Muirhead DATE
Manager
Mechanical Systems Development
Section 352

April 1993

JPL
Jet Propulsion Laboratory
California Institute of Technology

JPL D-9984

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Section 6.1 - Terminals

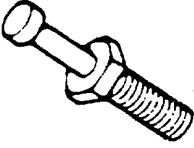
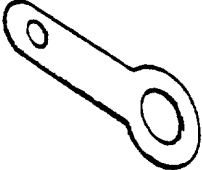
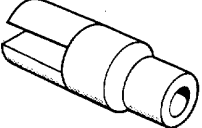
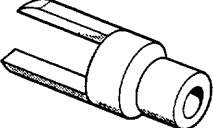
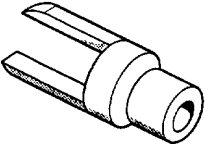
April 1993



JPL D-9984

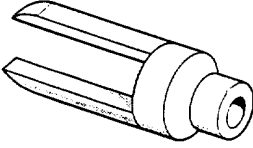
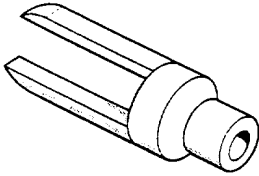
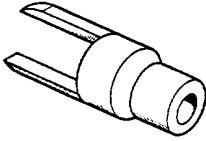
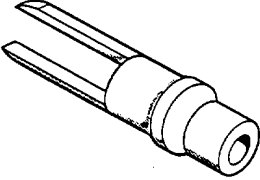
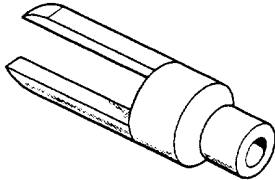
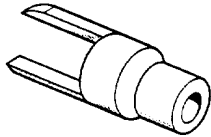
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Table 6-1. Terminals

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Terminal, Grounding, Stud Mounting	2.18 mm (.086") (2)-56 <u>Length</u> <u>mm</u> <u>inch</u> 1.57 0.062 3.18 0.125 4.78 0.188 6.35 0.250 7.92 0.312	ST10004		JPL
	Terminal, Flat Lug, Solder Coated	<u>Mounting Hole Diameter</u> <u>mm</u> <u>inch</u> 2.36 0.093 3.05 0.120 3.30 0.130 3.66 0.144 4.29 0.169 4.98 0.196 6.35 0.250	ST10009		ZIR
	Terminal, Electrical, Slotted, Swage Mount	<u>Board Thickness</u> <u>mm</u> <u>inch</u> 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250 3.967 0.1562 4.765 0.1875	ST10591 without thru-hole		
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> <u>mm</u> <u>inch</u> 0.396 0.156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250 3.967 0.1562 4.765 0.1875	ST11076 without thru-hole		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> <u>mm</u> <u>inch</u> 0.396 0.156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250 3.967 0.1562 4.765 0.1875	ST11083 with thru-hole		JPL

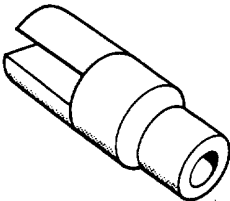
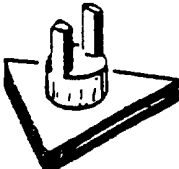

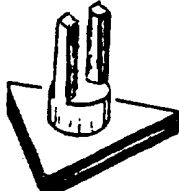
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Table 6-1. Terminals (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.79 0.031 1.59 0.062 2.38 0.093	ST11202		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250	ST11203		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250	ST11204 without thru-hole		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250	ST11205 tall base		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250	ST11299 large dia. base		JPL
	Terminal, Electrical, Bifurcated, Swage Mount	<u>Board Thickness</u> mm inch 0.396 0.0156 0.792 0.0312 1.585 0.0625 2.382 0.0938 3.170 0.1250	ST11300		JPL

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Table 6-1. Terminals (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code																
			JPL	Military or Industry																	
	Terminal, Electrical Slotted, Swage Mount	<u>Board Thickness</u> <table><tr><td>mm</td><td>inch</td></tr><tr><td>0.396</td><td>0.0156</td></tr><tr><td>0.792</td><td>0.0312</td></tr><tr><td>1.585</td><td>0.0625</td></tr><tr><td>2.382</td><td>0.0938</td></tr><tr><td>3.170</td><td>0.1250</td></tr><tr><td>3.967</td><td>0.1562</td></tr><tr><td>4.763</td><td>0.1875</td></tr></table>	mm	inch	0.396	0.0156	0.792	0.0312	1.585	0.0625	2.382	0.0938	3.170	0.1250	3.967	0.1562	4.763	0.1875	ST11308 with thru-hole		JPL
mm	inch																				
0.396	0.0156																				
0.792	0.0312																				
1.585	0.0625																				
2.382	0.0938																				
3.170	0.1250																				
3.967	0.1562																				
4.763	0.1875																				
	Terminal, Spot, Bifurcated (For modification and rework of PWB)		<u>ST11420</u> (Includes ST11076 terminal)		JPL																
	Terminal, Spot, Bifurcated (For modification and rework of PWB)		<u>ST11250</u> (Includes ST11204 terminal)		JPL																
	Terminal, Spot, Bifurcated (For modification and rework of PWB)		<u>10101948</u> (Includes ST11202 terminal)		JPL																

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Section 6.2 - Semiconductor Accessories


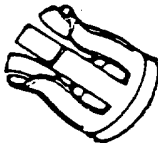
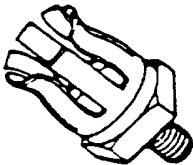


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Table 6-2. Semiconductor Accessories

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Transipad, Semiconductor	TO-18, 4 Hole TO-5, 3 Hole TO-99, 8 Hole	DS80	10042-DAP 10012-DAP 10193-DAP or 10195-DAP	Milton Ross Company
	Semiconductor, Heat Sink, Ceramic Insulated	TO-5 10-32 Stud		TX0505ND	IER
	Semiconductor, Heat Sink, Ceramic Insulated, Stud Mounted	TO-5	ST10041	TX0506-2B	IER
	Insulator, Semiconductor, Mica Washer	<u>Bolt Size</u> <u>mm</u> <u>inch</u> 2.28 4 4.83 10 6.35 1/4 7.94 5/16	ST10038	5624-120-2 5624-55-3 5624-79-3 5624-91-3	Seastrom Manuf. Company
	Insulator, Semiconductor, Shoulder Washer	<u>Bolt Size</u> <u>mm</u> <u>inch</u> 2.28 4 4.83 10 6.35 1/4 7.94 5/16	10092174-106 10092174-102 10092174-103 10092174-104		JPL

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Section 6.3 - Packaging Modules and Accessories

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THIS SECTION HAS BEEN DELETED IN ITS ENTIRETY.

CONTACT THE COGNIZANT ENGINEER OF SECTION 358
FOR SELECTION, APPROVAL AND ORDERING OF
SPECIAL PARTS BEFORE USAGE.

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Section 6.4 - Connectors

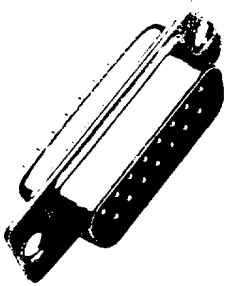
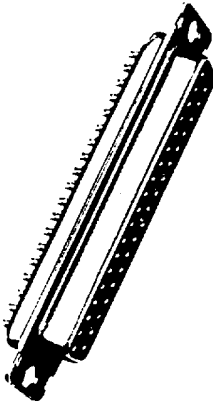
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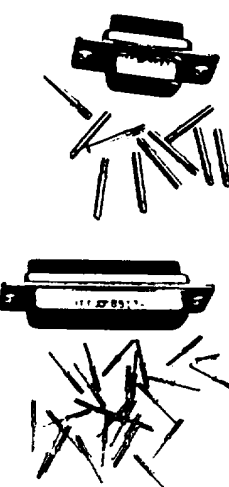
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Table 6-4. Connectors

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
  <p>NOTE: 15-pin and 37-socket units are shown: for details on other sizes, see suppliers' catalogs.</p>	Connector, Rectangular, Solder Type, 9 Pin	DEM-9P-NM-10	ST10091-9 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 9 Socket	DEM-9S-NM-10	ST10092-9 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 15 Pin	DAM-15P-NM-10	ST10091-15 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 15 Socket	DAM-15S-NM-10	ST10092-15 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 25 Pin	DBM-25P-NM-10	ST10091-25 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 25 Socket	DBM-25S-NM-10	ST10092-25 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 37 Pin	DCM-37P-NM-10	ST10091-37 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 37 Socket	DCM-37S-NM-10	ST10092-37 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 50 Pin	DDM-50P-NM-10	ST10091-50 Specification 20045/200		JPL
	Connector, Rectangular, Solder Type, 50 Socket	DDM-50S-NM-10	ST10092-50 Specification 20045/200		JPL

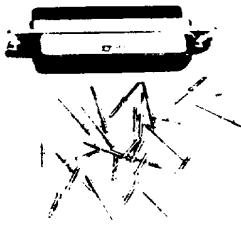
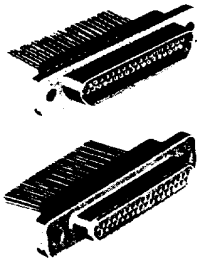
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Vendor Part Number (Reference)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
<p>NOTE: 9 pin and 37 pin connectors are shown; for details on other sizes, see suppliers' catalogs.</p> 	Connector, Rectangular, Crimp Type, 9 Pin	DEMA-9P-NMC-77	ST11957-9 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 9 Socket	DEMA-9S-NMC-77	ST11956-9 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 15 Pin	DAMA-15P-NMC-77	ST11957-15 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 15 Socket	DAMA-15S-NMC-77	ST11956-15 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 25 Pin	DBMA-25P-NMC-77	ST11957-25 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 25 Socket	DBMA-25S-NMC-77	ST11956-25 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 37 Pin	DCMA-37P-NMC-77	ST11957-37 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 37 Socket	DCMA-37S-NMC-77	ST11956-37 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 50 Pin	DDMA-50P-NMC-77	ST11957-50 Specification CS512091		JPL
	Connector, Rectangular, Crimp Type, 50 Socket	DDMA-50S-NMC-77	ST11956-50 Specification CS512091		JPL







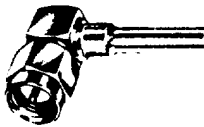
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Vendor Part Number	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Connector, Rectangular, Crimp Type, (15,26,44,62,78,104) Pin	D*MA-*P-NMC-77	ST12023 (1-6) SPGC CS512091		JPL
	Connector, Rectangular, Crimp Type, (15,26,44,62,78,104) Socket	D*MA-*S-NMC-77	ST12024 (1-6) SPGC CS512091		JPL
 <p align="center">NOTE</p> <p>37 contact connectors are shown; for details on other sizes, see supplier's catalogs.</p>	Connector, Electrical, Harnessed, Micro "D", 9 Pin Contacts		ST12017-9		JPL
	Connector, Electrical, Harnessed, Micro "D", 9 Socket Contacts		ST12018-9		JPL
	Connector, Electrical, Harnessed, Micro "D", 15 Pin Contacts		ST12017-15		JPL
	Connector, Electrical, Harnessed, Micro "D", 15 Socket Contacts		ST12018-15		JPL
	Connector, Electrical, Harnessed, Micro "D", 25 Pin Contacts		ST12017-25		JPL
	Connector, Electrical, Harnessed, Micro "D", 25 Socket Contacts		ST12018-25		JPL
	Connector, Electrical, Harnessed, Micro "D", 37 Pin Contacts		ST12017-37		JPL
	Connector, Electrical, Harnessed, Micro "D", 37 Socket Contacts		ST12018-37		JPL
	Connector, Electrical, Harnessed, Micro "D", 51 Pin Contacts		ST12017-51		JPL
	Connector, Electrical, Harnessed, Micro "D", 51 Socket Contacts		ST12018-51		JPL



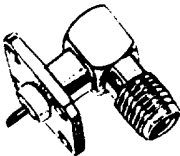



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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Recommended Coax Cable	Part Procurement Document and Applicable Dash Number		Source Code
			JPL Part No.	Vendor Part No.	
	Connector, Plug, RF, SMA	RG-188, RG-316	ST10204-2	2031-5003-00 (OSM 501-3)	JPL
	Connector, Plug, Right Angle, RF, SMA	RG-188, RG-316	ST10831-2	2037-5006-00 (OSM 521-3)	JPL
	Connector, Plug, RF, SMA	RG-141, RG-142, RG-303	ST10204-1	2031-5002-00 (OSM 501-1)	JPL
	Connector, Plug, Right Angle, RF, SMA	RG-141, RG-142, RG-303	ST10831-1	2037-5005-00 (OSM 521-1)	JPL
	Connector, Plug, RF, SMA, Soldered Center Contact	RG-402	ST11333-1	2001-5003-00 (OSM 207-1)	JPL
	Connector, Plug, RF, SMA, Semirigid	RG-402	ST10824-1	2001-5031-00 (OSM 201-1A)	JPL
	Connector, Plug, Right Angle, RF, SMA	RG-402	ST10827-1	2007-7941-00 (OSM 221-1)	JPL

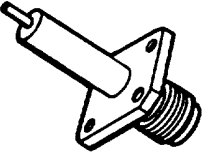
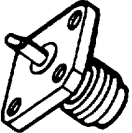
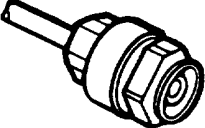
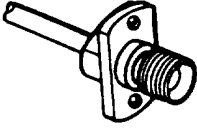
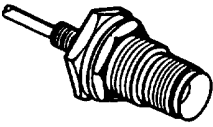
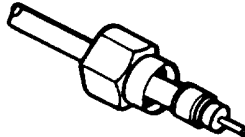
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL Part Number	Vendor Part Number	
	Connector, Jack, Two Hole Flange Mount, RF, SMA, Captured Center Contact, Solder Pot		ST11962-1	2052-1300-00 (OSM 244-2)	JPL
	Connector, Jack, Four Hole Flange Mount, RF, SMA, Captured Center Contact		ST10203-1	2052-0000-00 (OSM 215)	JPL
	Connector, Jack, Four Hole Flange Mount, Right Angle, RF, SMA, Solder Pot Contact, Solder Pot		ST11246-1	2054-0000-00 (OSM 224)	JPL
	Connector, Jack to Jack, Bulkhead Feedthrough, RF, SMA		ST10957-1	2084-0000-00 (OSM 209A)	JPL
	Connector, Jack, RF, SMA	RG-402	ST10826-1	2004-7941-00 (OSM 210-1)	
	Connector, Jack to Jack, Bulkhead, Feedthrough, RF, TNC			4132-6002	SOD

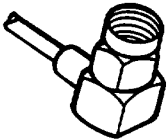
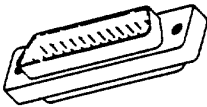
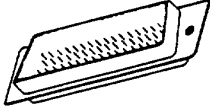


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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Vendor Part Number	
	Connector, RF Coaxial Flange Mount, Captured Center Contact, Jack/Terminal		<u>ST10618</u> -1	2052-1201-00 (AMI) OSM 204CC	JPL AMI OSM
	Connector, RF, Flange Mount, Captured Center Contact, Jack/Terminal, (Solder Pot)		<u>ST10203</u> -1	2052-0000-00	JPL OSM
	Connector, Coaxial, RF, TNC, Plug, Semirigid Cable	RG-402 RG-405	<u>ST12029</u> -1 -2	228179-2 228179-4	JPL API
	Connector, Coaxial, RF, SMA, Jack, Flange Mounted, 2-Hole, Semirigid Cable	RG-402 RG-405	<u>ST12035</u> -1 -2	221676-1 221666-1	JPL API
	Connector, Coaxial, RF, TNC, Jack, Bulkhead Mounted, Semirigid Cable	RG-402 RG-405	<u>ST12030</u> -1 -2	228502-1 228507-1	JPL API
	Connector, Coaxial, RF, SMA, Plug, Retractable Coupling Nut, Semirigid Cable	RG-402 RG-405 RG-402 RG-405	<u>ST12031</u> -1 -2 -3 -4	227531-5 221447-5 2001-5368-02 2001-5537-02	JPL API OSM

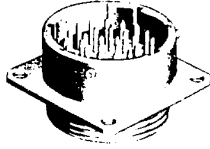

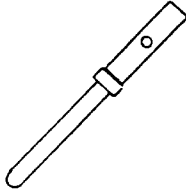
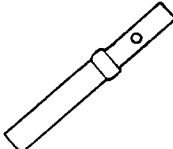
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Connector, Coaxial, RF, SMA, Plug, Right Angle, Semirigid Cable	RG-402 RG-405	<u>ST12032</u> -1 -2	228626-1 228583-1	JPL API
	Connector, Saver, Electrical, Rectangular, Nonmagnetic	"D" Series	ST11998-9PS ST11998-37PS ST11998-15PS ST11998-50PS ST11998-25PS Specification CS512091		JPL
	Connector, Electrical, Male Contact, Close Tolerance, Flex Print	"D" Series	ST 11493-15 ST11493-50 ST11493-37 ST11493-25 Specification 20045/200		JPL
	Connector, Circular, Wall Mounting Receptacle (pin or socket)	DS311-8-2 DS311-8-4	DS311 (P/S) Specification ZPH-2245-0300		JPL
	Connector, Circular, Straight Plug (pin or socket)	DS313-8-2 DS313-8-4	DS313 (P/S) Specification ZPH-2245-0300		JPL

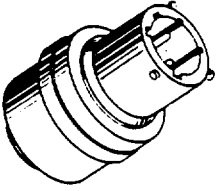
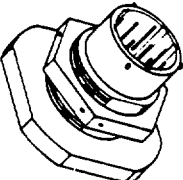
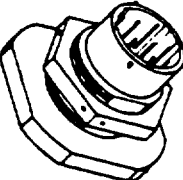
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Connector, Electrical, Receptacle, Wall Mounting, Circular, Miniature, Crimp Type, Quick Disconnect (Pin or Socket)	-16N8 -22N12 ST11953-10N6 -16N26 -22N21 ST11953-12N3 -18N8 -22N55 ST11953-12N10 -18N11 -24N19 ST11953-14N4 -18N32 -24N31 ST11953-14N5 -20N16 -24N61 ST11953-14N19 -20N41	ST11953 (P/S) Specification CS512089		JPL
	Connector, Electrical, Plug, Circular, Miniature, Crimp Type, Quick Disconnect (Pin or Socket)	-16N8 -22N12 ST11954G10N6 -16N26 -22N21 ST11954G12N3 -18N8 -22N55 ST11954G12N10 -18N11 -24N19 ST11954G14N4 -18N32 -24N31 ST11954G14N5 -20N16 -24N61 ST11954G14N19 -20N41	ST11954 (P/S) Specification CS512089		JPL
	Contact, Electrical, Pin, Crimp Type, Removable	ST11958-1-2026 ST11958-2-2026 ST11958-1-20 ST11958-3-22D ST11958-1-16 ST11958-1-12 ST11958-2-20	ST11958		JPL
	Contact, Electrical, Socket, Crimp Type, Removable	ST11959-1-2026 ST11959-2-2026 ST11959-1-20 ST11959-3-22D ST11959-1-16 ST11959-1-12 ST11959-2-20	ST11959		JPL

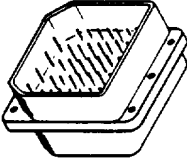
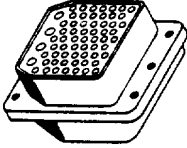
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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Connector, Saver, Electrical, Circular, Nonmagnetic	DS320-8-4 DS320-18-32 DS320-10-6 DS320-20-41 DS320-12-10 DS320-22-21 DS320-14-19 DS320-22-55 DS320-16-8 DS320-24-61 DS320-16-23 DS320-16-26	DS320 (PS or SP) Specification ZPH-2245-0300		JPL Special Order Only
	Connector, Circular, Hermetic, Jam Nut Mounting	Use only dash number listed on ST	ST10078 -1 thru -14 Specification ZPH-2245-0300		JPL
	Connector, Circular, Hermetic, Jam Nut Mounting (Leak Tested Assembly)	Use dash number listed on ST	ST11376 -1, -2, -3, -4		JPL

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Table 6-4. Connectors (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Connector, Electrical, Receptacle, In-Flight Disconnect		ST10205		JPL
	Connector, Electrical, Plug, In-Flight Disconnect		ST10206		JPL

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Section 6.5 - Wire


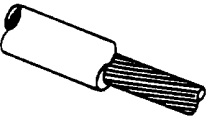

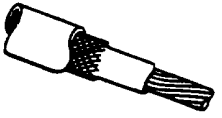

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Table 6-5. Wire

Part Identification	Part Description	Part Size(s)	Qualifying Part Use	Part Procurement Document and Applicable Dash Number		Source Code
				JPL	Military or Industry	
	Solid Copper Wire, Tinned and Annealed	<u>AWG</u> 16 thru 26	Bus Wire	ST10837	QQ-W-343 Type S Copper, Tinned and Annealed	SWC ALW NAT
	Stranded Copper Wire, Teflon (TFE) Insulated, Clear (350 V) Bondable	<u>AWG</u> 12 thru 28 14 and 18 AWG Special Order only *	Spacecraft Cabling and Electronic Equipment Intraconnections	ST11478-12 thru ST11478-28 Specification ZPH-2239-0940		JPL Except AWG 14 and 18 not stocked
	Twisted Groups, No Shield or Jacket Twisted Pair, Twisted Triad, Twisted Quad, T5, T6	<u>AWG</u> 12 thru 28 (Unshielded) Not all wire gages stocked in all configurations *	Electromagnetic Compensation	ST11480 ST11482 ST11484 ST11489 Specification ZPH-2239-0940		JPL Except AWG 12 and 16 special order only Except AWG 14 and 18 not stocked
	Shielded and Jacketed Hookup Wire, Single Conductor, Twisted Pair, Twisted Triad, Twisted Quad, T5, T6	<u>AWG</u> 20 thru 28 (Shielded) Not all wire gages stocked in all configurations *	Cabling for RF Shielding	ST11479 ST11481 ST11483 ST11485 ST11490 ST11492 Specification ZPH-2239-0940		JPL
	Cable, Coaxial, Miniature, Single Conductor, Dual-Shielded, Jacketed, 50-ohm	RG142 A/U 0.206 RG142 B/U 0.195	RF Shielding	<u>ST11225</u> -1, -2	MIL-C-17 MIL-C-17/60	QPL-17

*Contact appropriate cognizant activity concerning specific item availability or sizes not listed.

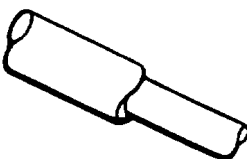
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Table 6-5. Wire (Cont'd)

Part Identification	Part Description	Part Size(s)	Qualifying Part Use	Part Procurement Document and Applicable Dash Number		Source Code
				JPL	Military or Industry	
	Cable, RF, Single Conductor, Shielded, 4.32 mm (0.170") Diameter, 50-ohm	RG-303 (Formerly RG-141)	RF Shielding		MIL-C-17 MIL-C-17/111	Per QPL-17
	Cable, RF, Single Conductor, Shielded, 2.59 mm (0.102") Diameter, 50-ohm	RG-316 (Formerly RG-188)	RF Shielding		MIL-C-17 MIL-C-17/113	Per QPL-17
	Cable, RF, Semirigid, Single Conductor, Shielded, 3.58 mm (0.141") Diameter, 50-ohm	RG-402	RF Shielding		MIL-C-17 MIL-C-17/130	Per QPL-17
	Cable, RF, Semirigid, Single Conductor, Shielded, 2.18 mm (0.086") Diameter, 50-ohm	RG-405	RF Shielding		MIL-C-17 MIL-C-17/133	Per QPL-17

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Table 6-5. Wire (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number		Source Code
			JPL	Military or Industry	
	Wire, Solderless Wrap, 200°C(392°F) PTFE Insulation, Silver Coated Copper Conductor	<u>AWG Size)</u>	<u>ST12019</u>	MIL-W-81822/6	JPL
		18	-18	M81822/6-A18-9	
		20	-20	M81822/6-A20-9	
		22	-22	M81822/6-A22-9	
		24	-24	M81822/6-A24-9	
		26	-26	M81822/6-A26-9	
		28	-28	M81822/6-A28-9	
		30	-30	M81822/6-A30-9	
		32	-32	M-W-16878/6	

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Section 6.6 - Cabling Accessories

April 1993




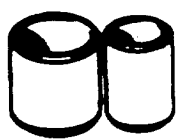

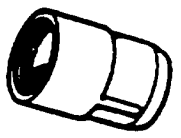



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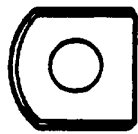
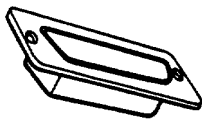
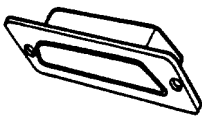
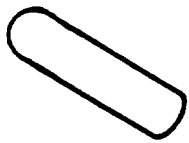
Table 6-6. Cabling Accessories

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number			Source Code
			JPL	Military or Industry	Manufacturer's Part Designation	
	Strap, Cabling, Self Locking, TEFZEL	Bundle Diameter Range: <u>mm</u> <u>inch</u> 1.59-15.9 1/16 - 5/8 1.59-44.5 1/16 - 1-3/4 4.76-88.9 3/16 - 3-1/2 1.59-101.6 1/16 - 4	<u>ST12014</u> -1 -2 -3 -4		<u>T&B</u> TYZ-23M TYZ-25M TYZ-27M TYZ-28M	TBC
	Clamp, Aluminum, Silicone Rubber Insulated	<u>12.7 mm (1/2") Wide - #10 Screw</u> 3.18 thru 76.2 mm (1/8" thru 3")	<u>ST12012</u> -2 thru -48		TA022() WF	TAM
	Clamp, Aluminum, Nonslip Teflon Insulated	<u>12.7 mm (1/2") Wide - #6 Screw</u> 3.18 thru 31.8 mm (1/8" thru 1-1/4")			<u>TA570</u> TA570TD () X TA570D () X	TAM
	Ferrule, Two Piece Uninsulated Shield Grounding	<u>Sleeves:</u> <u>Inner:</u> <u>Outer:</u> 1.17 mm 2.57 mm (0.046") (0.101") to to 9.53 mm 12.7 mm (0.375") (0.500")	<u>ST10039</u> <u>Inner:</u> <u>Outer:</u> -1 -50 to to -31 -76		<u>Inner:</u> GSB-046 to GSB-357 <u>Outer:</u> GSC-101 to GSC-500	TBC
	Boot, Potting, Threaded, Aluminum Shell Size 8 thru 24	Shell Size: 8 thru 24 for Connectors per DS311, DS313, ST11948, ST11949, ST11953, and ST11954	<u>ST12021-(1,2)-</u> -8 -18 -10 -20 -12 -22 -14 -24 -16		901-()	JPL
	Boot, Potting, * Threaded, Nylon Shell Size 8 thru 24	Shell Size: 8 thru 24 for Connectors per DS311 and DS313	DS8837			JPL
	Boot, Potting, * D Series Subminiature Connector	Used on "D" Series Connectors per ST10091 and ST10092	<u>DS8828</u> -9 9 Contact -15 15 Contact -25 25 Contact -37 37 Contact -50 50 Contact			JPL

*This item requires outgassing by heating to 250°F for 24 hours at a pressure of 10⁻⁵ torr prior to spacecraft use.

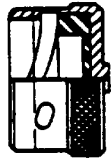



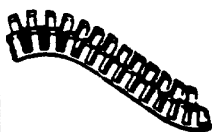

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Table 6-6. Cabling Accessories (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number			Source Code
			JPL	Military or Industry	Manufacturer's Part Designation	
	Boot, Potting, Subminiature Connector, D-Series, Metal	MS Shell Size (Ref) 1 2 3 4 5	<u>ST12025</u> -9 -15 -25 -37 -50	DE44994-5NM-A156 DA44994-1NM-A156 DB44994-2NM-A156 DC44994-3NM-A156 DD44994-4NM-A156	JPL ITT CANNON	
	Clamp "D" Washer, Aluminum	<u>Mounting Hole</u> <u>mm</u> <u>inch</u> 3.25 0.128" 3.56 0.140" 4.24 0.167" 4.85 0.191"	<u>ST10071</u> -61 -62 -63 -64		"D" Washers A6-128 A6-140 A6-167 A6-191	WCI
	Cover, Connector, Electrical, Female, Rectangular, Non-Magnetic	MS Shell Size (Ref)	<u>ST12037</u> -1 -2 -3 -4 -5 -6	DE351196-5 DA351192-6 DB351193-5 DC351194-5 DD351195-5 TBD	JPL ITT CANNON	
	Cover, Connector, Electrical, Male, Rectangular, Non-Magnetic	MS Shell Size (Ref)	<u>ST12038</u> -1 -2 -3 -4 -5 -6		JPL ITT CANNON	
	Insulator, Shrinkable, Splice Caps	<u>Recovered ID</u> <u>mm</u> <u>inch</u> 0.64 0.025" 1.27 0.050" 2.54 0.100" 4.45 0.175" 6.35 0.250"	<u>ST10018</u> -1 -2 -3 -4 -5		<u>Electronized Chemical Corp</u> <u>Caps</u> SRC-1 SRC-2 SRC-3 SRC-4 SRC-5	ECC

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Table 6-6. Cabling Accessories (Cont'd)

Part Identification	Part Description	Part Size(s)	Part Procurement Document and Applicable Dash Number			Source Code
			JPL	Military or Industry	Manufacturer's Part Designation	
	Cover, Protective, * Connector Receptacle, Electrical, Bayonet Coupler (for use with DS311, DS312, DS315, DS316, DS317)	<u>Shell Size:</u> 8 thru 24	<u>DS318</u> -8 thru -24 Spec ZPH- 2245-0300			BXC
	Mounting Base, * Cabling Strap, Nylon	For 4.67 mm (0.184") width strap	ST11281 (0.184 width only)		TC-112	TBC
	Mounting Base, * Cable Strap, Nylon	<u>Strap Width</u> <u>Screw Size</u> .091 #4 Pan Head .184 #6 Pan Head .301 #10 Pan Head			<u>TBC</u> <u>-PAN</u> TC-140 TM1S4 TC-141 TM2S6 TC-142 TM3S10	TBC PAN
	Mounting Base, * Cable Strap, Nylon	For 4.67 mm (0.184") width strap. Epoxy adhesive mounting			TC-817	TBC
	Grommet, * Universal, Nylon (Caterpillar)	<u>Metal Thickness</u> 0.38-1.32 mm (0.015 - 0.052") 1.32-2.16 mm (0.052 - 0.085") 2.16-3.25 mm (0.085 - 0.128")	<u>ST10762</u> -1 -1 -2 -2 -3 -3		WG-100 WG-200 WG-300	WCI
	Spacer, Cylindrical, Aluminum, Black Anodized	<u>Thread Sizes:</u> .112 (4) - 40 .138 (6) - 32 .164 (8) - 32 .190 (10) - 32 Length by 1/8 to 1.0 and 1.250	<u>ST10853</u> -1 thru -30			JPL

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Section 7.0 - Transformers and Inductor Elements


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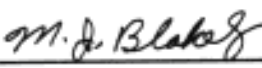


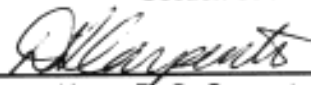
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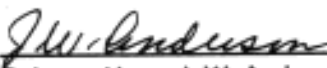
Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide


Section 7.0 - Transformers and Inductor Elements

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 3/17/93
Released by: J. W. Anderson DATE
Technical Editor
Documentation
Section 648

 3/15/93
Approved by: T. P. O'Donnell DATE
Deputy Manager
Space Materials Science &
Engineering
Section 355

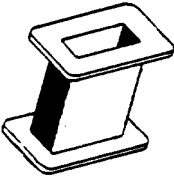
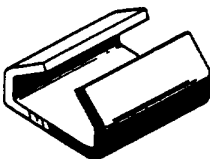
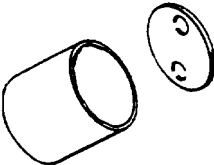
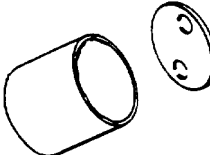
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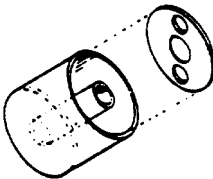
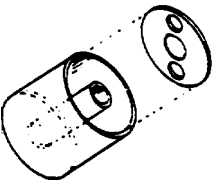
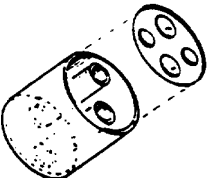
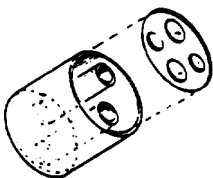
Table 7-1. Transformers and Inductor Elements

Part Identification	Part Description	Part Size(s)	Qualifying Part Use	Part Procurement Document and Applicable Dash Number		Source Code
				JPL	Military or Industry	
	Bobbin Rectangular Fiberglass-Epoxy	Various	Transformer and Inductor Bobbin	None	See DCE Catalog	DCE
	Strap, Transformer Banding, Phosphor Bronze	Order by Length	Banding Strap for "C" and "E" Cores	<u>ST10612</u> Size 3/16 x 0.006 3/8 x 0.006 3/8 x 0.012		BKS
	Strap, Transformer Banding, Tinned Steel	Order by Length	Banding Strap for "C" and "E" Cores	<u>ST10613</u> Size 3/16 x 0.006 3/8 x 0.006 3/8 x 0.012		GER
	Seal, Transformer Strap, Tinned Steel	1592-1M	Banding Strap Clamping "Seal" for "C" and "E" Cores	<u>ST10614</u> Width 0.200 0.430		GER
	Cup, Potting*, Cylindrical, Epoxy, Glass Laminate, Natural Color	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup, No Mounting Hole	ST10185		DCE
	Cup, Potting*, Cylindrical, Epoxy, Glass Laminate, Black Dyed	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup, No Mounting Hole	ST10602		DCE

*Potting enclosures other than those shown are allowed with the approval of the Electronic Equipment Engineering and Fabrication Section.

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Table 7-1. Transformers and Inductor Elements (Cont'd)

Part Identification	Part Description	Part Size(s)	Qualifying Part Use	Part Procurement Document and Applicable Dash Number		Source Code
				JPL	Military or Industry	
	Cup, Potting*, Cylindrical, Epoxy Glass Laminate, Center Mounting Hole, Natural Color	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup	ST10603 -1 to -861		DCE
	Cup, Potting*, Cylindrical, Epoxy Glass Laminate, Center Mounting Hole, Black Dyed	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup	ST10604 -1 to -861		DCE
	Cup, Potting*, Cylindrical, Epoxy Glass Laminate, Two Mounting Screw Holes, Natural Color	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup	ST10605		DCE
	Cup, Potting*, Cylindrical, Epoxy Glass Laminate, Two Mounting Screw Holes, Black Dyed	Size (ID) 1.27 x 1.27 mm to 76.2 x 76.2 mm (0.5 x 0.5" to 3.00 x 3.00")	Transformer and Inductor Potting Cup	ST10606 -1 to -861		DCE
	Wire, Magnet, Copper, Class 130°C (266°F)	AWG Size 14 thru 44	Winding of Magnetics	ST10866		J-W-1177A/9

*Potting enclosures other than those shown are allowed with the approval of the Electronic Equipment Engineering and Fabrication Section.

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Table 7-1. Transformers and Inductor Elements (Cont'd)

Part Identification	Part Description	Part Size(s)	Qualifying Part Use	Part Procurement Document and Applicable Dash Number		Source Code
				JPL	Military or Industry	
—	Wire, Magnet, Copper, Class 155°C (311°F)	AWG Size 14 thru 44	Winding of Magnetics	ST10219		Qualified to J-W-1177A/10
—	Wire, Magnet, Copper, Class 200°C (392°F)	AWG Size 14 thru 41	Winding of Magnetics	ST11027		Qualified to J-W-1177A/14
—	Eccofoam SH Polyurethane Rigidized 10/lb/ft ³ Maximum Temperature 135°C (275°F)		Transformers and Inductors; Potting Cup Filler	BS502640	—	EMC

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Appendix A- Code Listing of Manufacturers

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JPL-STD00009 Rev. B**1992****Appendix A: Code Listing of Manufacturers**

CODE	MANUFACTURER AND ADDRESS
A	
ABL	Ablestick Laboratories, Rancho Dominguez, CA 90221
ACYa	American Cyanamide Co., Bloomingdale Dept. Havre DeGrace, MD 21078
ACYb	American Cyanamide Co., Plastics Dept., Wallingford, CT 06492
AKZ	AKZO Coatings America Inc., Sikkens Aerospace Finishes Div., Torrance, CA 90502
ALW	Alpha Wire Corp., Elizabeth, NJ 07207
AMI	American Microwave Inc. Inc., Waltham, MA 26805
AMO	AMOCO Performance Products, Long Beach, CA 90806
AMPa	Amphenol Corp., Bendix Connector Operations, Sidney, NY 13838
AMPb	Amphenol Fiberoptics Products, Lisle, IL 60532
AMX	Alpha Metals Inc., Jersey City, NJ 07304
APM	Apex Mills Inc., New York, NY 10018
APX	Amperex Electronic Corp., Ferrox Cube Div., Saugerties, NY 12477
ATD	American Thread Co., Stamford, CT 06905
AVO	AVCO Corp., (see TEX)
B	
BAS	BASF Structural Materials, Anaheim, CA 92806 (formerly NARMCO)
BDY	Brady W. H. Co., Industrial Products Div., Milwaukee, WI 53209
BHM	Bentley-Harris Mfg. Co., Lionville, PA 19353
BID	Biddle Instruments, Bluebell, PA 19422
BII	Bacon Industries Inc., Watertown, MA 02172
BKS	Brooks, E. Jordan, Newark, NJ 07107
BLI	Blinn Dilbert and Co., Inc., Pomona, CA 91766
BLU	Blue Mountain Ind., Carisbrook Co., Blue Mountain, AL 36201
BPC	B. P. Chemicals Hitco, Fibers and Materials, Gardena, CA 90249
BTE	Brushtronics Engineering, Laurel, MD 20707
BRC	(See AMPb)
BSP	Baxter Scientific Products, Irvine, CA 92714
BWC	Brush Wellman Co., Elmore, OH 43416
C	
CAB	Cabot Corp., Boyertown, PA 19512
CAM	Coats American, Charlotte, NC 28217
CAS	Castrol, Inc., Irvine, CA 92214 (was Bray Oil Co.)

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Appendix A: Code Listing of Manufacturers

CODE	MANUFACTURER AND ADDRESS
C (cont'd)	
CCC	Columbian Chemical Co., Div. of Phelps Dodge Corp., Atlanta, GA 30339
CEX	C. E. Minerals, King of Prussia, PA 19406
CHO	Chomerics Inc., Woburn, MA 01801
CHRa	CHR/Rolling Meadows Division, Furon, Rolling Meadows, IL 60008
CHRB	CHR Division of Furon, New Haven, CT 06509
CLP	C-LEC Plastics, Beverly, NJ 08010
CMC	Coventry Mfg. Co., Inc., Baldwin Park, CA 91706
CON	CONAP Inc., Olean, NY 14760
COR	Corning Inc., Corning, NY 14831
CPC	Coors Porcelain Co., Golden, CO 80401
CTP	Crocker Technical Papers Inc., Fitchburg, MA 01420
D	
DCC	Dow Corning Co., Midland, MI 48640
DCE	DORCO Electronics, Paramount, CA 90723
DCM	Dexter Crown Metro, Div. of Dexter Aerospace, Hayward, CA 94544
DDL	Dicronite Dry Lube, Div. Rotary Components, Inc., Covina, CA 91723
DEM	Dexter Electronic Materials, Industry, CA 91746
DEX	Dexter Hysol Aerospace Materials Div., Pittsburgh, CA 94565
DIC	Dixon Industries Corp., Div. of Furon Corp., Bristol, RI 02809
DNC	Dunmore Corp., Newton, PA 18940
DOW	Dow Chemical USA, Chemical Sales, City of Industry, CA 91744
DUPa	DuPont de Nemours, E. I. and Co. Inc., Polymer Products, Newark, DE 19714
DUPb	DuPont de Nemours, E. I. and Co. Inc., Imaging Products, Wilmington, DE 19898
DUPc	DuPont de Nemours, E. I. and Co. Inc., Electrical Specialty Div., Austin, TX 28726
DUPd	DuPont de Nemours, E. I. and Co. Inc., Fluorocarbon Div., Wilmington, DE 19898
E	
ECI	Emerson & Cuming Inc., Div. of Grace and Co., Canton, MA 02021
ELA	Electro Adapter Inc., Chatsworth, CA 91311
ELF	ELF Atochem No. America Inc., Philedelphia, PA 19102 (formerly Pennwalt)
ELI	Electrolock Inc., Chagrin Falls, OH 44022
EMC	E. M. Corporation, North Hollywood, CA 91605
ESP	Electronic Space Products International, Agoura Hills, CA 91301

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CODE	MANUFACTURER AND ADDRESS
	E (cont'd)
ETI	Epoxy Technology Inc., Billerica, MA 01821
	F
FAP	Furane Products, Div. of Ciba-Geigy Corp, Los Angeles, CA 90039
FAS	Fusco Abrasive Systems Inc., Compton, CA 90221
FIB	Fiberite, ICI Fiberite Inc., Winona, MN 55987
FLG	Fluorglas Unit, Allied Signal, Hoosick Falls, NY 12090
FRA	Fralock, Div. of Lockwood Ind. Inc., Canoga Park, CA 91406
FSC	Fisher Scientific Co., Fairlawn, NJ 07410
FUR	Furon, CHR Division, New Haven, CT 06509
	G
GECa	General Electric Co., Plastics Business Dept., Pittsfield, MA 02103
GECh	GE Silicones, Waterford, NY 12188
GER	Gerrard, A. J. and Co., Des Plaines, IL 60018
GOD	Goodrich Co., B. F., Akron, OH 44318
GOU	Gould Inc., Foil Div., Eastlake, OH 44094
GPM	General Plastics Mfg. Co., Tacoma, WA 98409
GUD	Gudebrod Inc., Pottstown, PA 19464
GWR	Grace, W. R. and Co., Dewey Almy Chemical Div. (Emerson & Cuming) Canton, MA 02021
	H
HBR	Hadbar Div. of Purosil Inc., Monrovia, CA 91016
HCL	Hercules Inc., Advanced Materials and Systems, Bacchus Works, Magna, UT 84044
HER	Heraeus Amersil Inc., Buford, GA 30518
HES	Haskell Engineering and Supply Co., Burbank, CA 91502
HIT	HITCO (B. P. Chemicals), Fibers and Materials, Gardena, CA 90249
HIV	High Voltage Engr. Corp., Electronized Chemicals Div., Burlington, MA 01803
HKL	Henkel Corp., Resins Div., Minneapolis, MN 55435
HPM	Homan Plating & Mfg. Inc., Dayton, OH 45404
HUJ	Huck Manufacturing Co., Sub of Federal-Mogul Corp., Irvine, CA 92714
HYS	Dexter Hysol Corp., Pittsburg, CA 94565
	I
ICI	ICI Composite Structures, Tempe, AZ 85284
IBC	Ibonex Corp., Melvindale, MI

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Appendix A: Code Listing of Manufacturers

CODE	MANUFACTURER AND ADDRESS
	I (cont'd)
IER	International Electronic Research Corp., Burbank, CA 91502
IIT	IIT Research Inst. (Illinois Inst. of Technology), Chicago, IL 60616
	J
JPL	Jet Propulsion Laboratory, Materials Engineering, Pasadena, CA 91109
	K
KEN	Kendall Company, Boston, MA 02101
KNR	Kaynar Microdot Aerospace Fastening Div., Fullerton, CA 92634
KSD	Kester Solder Division, Litton Systems Inc., Des Plaines, IL 60018
KST	King-Seeley Thermos Co., Thermos Div. Norwich, CT 06360
	L
LAB	Labsphere, North Sutton, NH 03260
LLC	Long-Lok Fasteners Corp., an Inlex Co., Gardena, CA 90249
LMC	Liberty Mirror, Div. of Swedlow Inc., Brackenridge, PA 15014
LOR	Lord Corp., Erie, PA 16512
LWD	Lockwood Ind. Inc., Fraylock Div., Canoga Park, CA 91304
	M
MAP	MAP S.A. Pamiers, France
MCS	Multicore Solders Inc., Richardson, TX 75081
MGN	McGhan NuSil Corp., Carpinteria, CA 93013
MLC	MALCO, a Microdot Co., So. Pasadena, CA 91030
MMMa	3M Co., Adhesive Systems Div., St. Paul, MN 55101
MMMb	3M Co., Commercial Chemical Div., St. Paul, MN 55101
MMMc	3M Co., Electrical Specialties Div., Austin, TX 78769
MMMd	3M Co., Industrial Specialties Div., St. Paul, MN 55101
MMMe	3M Co., Industrial Tape Div., St. Paul, MN 55101
MMMf	3M Co., Specialty Packaging Dept., Coated Fabrics, Monrovia, CA 91016
MMMg	3M Co., Identification & Converter Systems Div., St. Paul, MN 55101
MMMh	3M Co., Static Control Systems, 3M Electrical Specialties Div., Austin, TX 78769
MMMi	3M Co., Decorative Products Div., St. Paul, MN 55101
MPI	Metallized Products Inc., Winchester, MA 01890
MRT	Morton Int'l Industrial Coatings, Chicopee, MA 01020
MTC	M and T Chemical Co., Rahway, NJ 07065

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CODE	MANUFACTURER AND ADDRESS
	M (cont.)
MTI	Morton Thiokol Inc., Warsaw, IN 46580
MYT	Mystic Corp., (now Technical Laminations & Coatings; See TLC)
	N
NAT	National Wire and Cable Co., Los Angeles, CA 90031
NJZ	New Jersey Zinc Co., Monaca, PA 15061
NLI	N. L. Industries, N. L. Chemical Div., Hightstown, NJ 08520
NMX	National Metallizing, Cranbury, NJ 08512
NPP	Norton Performance Plastics, Wayne, NJ 07470
NRM	NARMCO (is now BASF Structural Materials Inc.,) Anaheim, CA 92806
NYG	NY-Glass Inc., Paramount, CA 90723
	O
OWC	Owens Corning Fiberglass Corp., Toledo, OH 43659
	P
PAN	Panduit Corp., Tinely Park, IL 60477
PEL	Pelmor Laboratories, Newton, PA 18940
PHCa	Parker-Hannifin Corp., O-Ring Div., Lexington, KY 40512
PHCb	Parker-Hannifin Corp., O-Seal Div., Culver City, CA 90230
PNN	Penn Engineering and Mfg. Corp, Danboro, PA 18916
PNT	Penntube Products Inc., Div. of Furon, Nickelson, NJ 08506
PPG	Precision Products Group, Inc., Stone Industrial Div., College Park, MD 20740
PRC	Products Research & Chemical Corp., (Courtaulds), Glendale, CA 91203
POT	Potter Industries Inc., Parsippany, NJ 07054
	R
RAK	Raychem Corp., Menlo Park, CA 94025
RAY	Raytheon Co., Lexington, MA 02173
REI	Reinhold Industries Inc., Santa Fe Springs, CA 90670
REV	Roberts, E. V. & Associates, Culver City, CA 90230
ROG	Rogers Corp., Manchester, CT 06045
ROH	Rohm Tech Inc., Malden, MA 02148
RXNa	Rexnord Inc., Rosan Div., Santa Ana, CA 92799
RXNb	Rexnord Inc., Tridair Ind., Torrance, CA 90502

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S	
SCA	Shell Chemical Co., Plastics & Resins Dept., Houston, TX 77210
SCC	Spacecraft Coatings Inc., Gambrills, MD 21054
SEA	Sealectro Corp., Trumbull, CT 06611
SGC	Superior Graphite Co., Chicago, IL 60606
SHD	Sheldahl Inc., Northfield, MN 55057
SGC	Superior Graphite Co., Chicago, IL 60606
SHD	Sheldahl Inc., Northfield, MN 55057
SHL	Shur-Lok Corp., Irvine, CA 92713
SHR	Sharp Chemical, Burbank, CA 91502
SIC	Stone Industrial Corp., College Park, MD 20740
SJP	Stevens, J. P., Glass Fabrics Div., Slater, SC 29683
SOD	Solitron Devices Inc., Solitron/Microwave Div., Port Salerno, FL 33492
SPL	Spaulding Composites Co., Tonawanda, NY 14150
SPS	Structural Polymeric Systems Inc., Los Angeles, CA 90016
STR	Stranco Products Inc., Michigan City, IN 46360
SWC	Standard Wire & Cable Co., El Segundo, CA 90245
T	
TAM	T. A. Manufacturing Co., Glendale, CA 91203
TMY	Thermalloy Co., Dallas, TX 75247
TBC	Thomas and Betts, Bridgewater, NJ 08807
TEL	Teledyne Ryan Aeronautical Co., San Diego, CA 92130
TEX	Textron Inc., Textron Specialty Materials Div., (was AVCO), Lowell, MA 01851
TLC	Technical Laminations and Coatings, Div. of Customs Tape Inc., Harwood Heights, IL 60656
U	
UCC	Union Carbide Corp., Specialty Chemicals Div., So Charleston, WV 25203
UNC	Uniroyal Chemical Co., Inc., Middlebury, CT 06749
V	
VAR	Variflex Corp., Rome, NY 13440
VOI	VOI SHAN Div. of VSI Corp., Culver City, CA 90230
W	
WCS	Westwood Ceramics Supply, City of Industry, CA 91744
WEC	Westinghouse Electric Corp., Micarta Div., Hampton, SC 29924

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	W (cont.)
WEL	Westinghouse Laminates, Div. of Allied Signal, Sylmar, CA 91342 (was Fortin)
WHIa	Whittaker Corp., Brunswick Coatings & Chemicals Div. Chicopee, MA 01020
WHIb	Whittaker Corp., Whittaker Haynes Div., Chicopee, MA 01020
	Z
ZIR	Zierick Manufacturing Co., Mt. Kisco, NY 10549

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Appendix B - Alphabetic Index for Nonmetallic Materials Specifications

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APPENDIX B

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AD995 Aluminum Oxide Polycrystalline	—	29
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Aeroglaze A276 Temp. Control Coating	Boeing BMS 1090A	51
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AKZO 443-1-500-T Temp. Control Coating	BS502652	52
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AKZO 463-6-14 Temp. Control Coating	BS513077	52
AKZO 463-6-27 Primer	MIL-C-22750	15
Aluminum Oxide, 325 Mesh or finer, KNC 3955	ASTM F7	58
Ameristat 1.5 Antistatic Film (replaced by SECO 707)	MIL-B-81705	57
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Ben-Har 1258; Sleeving	BS502602	62
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C		
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CAB-O-SIL M5 Colloidal Silica	BS502697	8,12,21,22,42,58
Calcofluor White, RWP (Indicator)	BS502696	21,59
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Catalyst A	BS502620	24
Chemfluor Teflon (TFE) Tubing	MIL-I-23053/12	44
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Chemglaze Z-306 Temp. Cntrl Coating (is now Aeroglaze Z306)	BS506303	51
Chemlok AP134 Primer	—	15
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CI-6/BA45 Epoxy Resin	MIL-C-82644 Type III	21
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Colloidal Silica (CAB-O-SIL, M5) (Filler)	BS502697	12,21,58
Conathane CE 1155 Polyurethane Coating	MIL-I-46058	21
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Cord, Lacing, Dacron	BS502604	60
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Dacron Thread (Star Ultra Dee)	BS505782	63
DC 6-1104 Silicone Rubber	BS506319	6,39
DC 93-500 Silicone Rubber	BS504221	6,40
DC 210 H Silicone Fluid	BS502562	59
DC 510 Polysiloxane Fluid	BS513529	59
Delrin 100 NC-10 Acetal Resin	BS502503	36
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Delrin 500 AF Acetal/Teflon Resin	BS504224	36
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Diall 52-40-40 Diallyl/Phthalate	BS502518	36
Dibutyl Tin Dilaurate (DBT) Silicone Catalyst	BS502698	58
Dicronite Dry Lubricant	DOD-L-85645	32
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EA 901NA/B-1 Epoxy Adhesive	BS502545	10
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EA 907 A/B Epoxy Adhesive	BS513317	10
EA 913/L-3 Epoxy Adhesive	BS502530	10
EA 934NA A/B Polyamide Adhesive	BS515055	10
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EA 956 A/B Epoxy Polyamide Adhesive	BS502534	11
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EA 9649R Epoxy Film Adhesive	BS513277	12
EC-2320 Primer	BS502555	4
Eccobond 55/9 Epoxy Adhesive	BS502501	6
Eccobond 56C/9 Silver-filled Epoxy Adhesive	BS502539	6
Eccobond 57C A/B Silver-filled Epoxy Adhesive	BS502572	7
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Eccofoam FPH/12-2H and FHP/12-6H	BS502575	59
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Eccofoam SH	BS502640	59
Eccospheres SI Filler	BS515845	58
Enamel APA 2474 Temp. Control Coating	BS501404	53
EPK 1C Adhesive	BS515787	12,39
Epiall 1914 Molding Compound	BS502642	36
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Epon 828 Epoxy Resin	BS502506	7,12,24
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Fabric, Nomex, Sheldahl	PN F015510	25
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Fluorglas 389-7 (Beta Cloth)	BS506328	25
Fluorocarbon (Teflon), FEP, Aluminized	BS502543	26,37
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G		
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Graphite Fabric, Preimpregnated, Epoxy Resin	BS506340	19
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I		
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J		
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K		
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Laminar X-500, Gloss Black (No. 4B1) Temp. Control Coating	BS502653	54
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M		
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Magna Coating of Teflon (See Laminar X-500, Teflon White)	BS504192	32
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MH-11Z Temp. Control Paint	BS513199	54

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Micarta H-2497 Epoxy/Fiberglass Laminate	BS502502	19
Micarta H17825 Silicone/Fiberglass Fabric	BS502500	19
Micarta HY-180 Epoxy/Fiberglass Tubing	BS502510	19
Micarta HY-180-1 Epoxy/Fiberglass Tubing	BS502510	19
MolyKote Z Powder	BS502619	33
MXB 7703/Fiberglass	BS504233	19
Mylar, Type A Film	BS502504	28
Mylar, Type A, Aluminized Film	BS502505	28
Mystik 6401 Tape (is now CT 941)	BS502688	46
Mystik 7000 Tape (is now CT 900)	BS502598	46
Mystik 7020 Tape (is now CT 920)	BS502549	46
Mystik 7021 Tape (is now CT 921)	BS504229	46
Mystik 7300 Tape (is now CT 901)	BS502599	46
Mystik 7367 Tape (is now CT 967)	BS506312	47
Mystik 7452 Tape and 7453 Tape (is now CT 625)	BS502649	47
N		
N-Aminoethylpiperazine (AEP) Curing Agent	BS506318	12
Nomex MH-69BS Thread	BS506324	63
Nonmagnetic, Electrically Cond. Thermal Control Paint	BS513330	55
NS43G, White, Thermal Control Paint	FS516165	55
Nylon Seine Twine	BS505784	64
O		
Optical Glass	MIL-G-174	60
P		
Paper, Fish, Armitte	ASTM D-619	61
Paper, Kraft, Transformer	ASTM D-619	61
Parker V709-90 Elastomer	BS504187	23
Parker V747-75 Elastomer	BS504186	23
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Pigment/Powder, Superior Graphite No. 9035	BS513199	61
Pigment/Powder, Zinc Oxide, SP-500	MIL-Z-37707	61
PLV 2000 2-part Adhesive	BS513522	8
Polyimide Glass Laminate (Unclad) Type GI	MIL-P-13949/13	19
Polyester Fabric	BS505773	25
Polyethylene, Bagging	MIL-B-22191	57
Polyimide Glass Laminate, Unclad, Type GI	MIL-13949/13	19
Polyimide Sheet, Pyralux LF 0100	MIL-P-46112	20
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Polysulfone Thermoplastic, P-1700, P-1710, P-3500	BS502603	37
PR 420 A/B 2-part Primer	BS502682	5

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Prepreg Class Cloth, Type GF	MIL-P-13949/12	19
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Pyrallux LF0100, Flex Printed Wire Laminate	MIL-P-46112	20
Pyrallux LF9120RA Flex Printed Wire Laminate	IPC-FC-241/1	20
R		
Radiation Shielding, Solithane 113		
Rexolite 1422 Molding Compound	BS502695	62
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RT/duriod 6010 Laminate	MIL-F-46194	61
RTV 11 Potting Compound	IPC-TM-650	17,20
RTV 60 Potting Compound	BS502611	40
RTV 566 A/B Potting Compound	BS502511	21,41
RTV CV-2510 Potting Compound	BS504228	8,41
Rulon AR Fluorocarbon Lubricant	BS514364	39
Rulon J Teflon Lubricant	BS504205	33
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	Pending	33
S		
S-13, S-13G/LO-1, White Thermal Control Paint		
S-1600 Sleeving	BS502617	56
Scotch Brand No. 5 Tape	MIL-I-3190/2,3	63
Scotch Brand No. 27 Tape	MIL-I-15126	47
Scotch Brand No. 56 Tape	ST10859	47
Scotch Brand No. 213 Tape	ST11099	47
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Scotchply SP-250-S29 Fiberglass Tape	BS502531	20
Scotchply UNI Type 1002 Fiberglass Laminate	MIL-P-18177	20
Scotchweld 2216 B/A Gray Adhesive	BS502533	14
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SECO 707 Antistatic Bagging Material	MIL-B-81705	57
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Shrinkable Mylar Tubing	BS502644	44
Sikkens 443-1-500T Temp. Control Coating (is now AKZO)	BS502652	52
Sikkens 463-3-8 Temp. Control Coating (is now AKZO)	BS501403	52
Sikkens 463-6-14 Temp. Control Coating (is now AKZO)	BS513077	52
Sleeving, Ben-Har, Acrylic, A, B, C and C-2	BS502645	62
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Sleeving, S-1600	MIL-I-3190/2	63
Sleeving, Insulation, Teflon	MIL-I-22129	63
Solithane 113 - No. 1 and No. 4 Primer	SAE/AMS 3137	16
Solithane 113/C113-300 (TIPA) Potting	BS502695	8,9,21,22,42,61
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Solvent, Chemglaze 9953	Lord Bulletin DS10-7067	63
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SS 4044 Adhesive Primer	BS502524	5
SS 4155 Adhesive Primer	BS504185	5
Stycast 1090/11 Potting	BS502526	42
Stycast 1090/24LV Potting	BS513312	43
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Suprasil 1 Quartz Glass (SiO ₂)	40-1015-079A	30
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Sylgard Primer	BS506314	5
T		
T-12 accelerator (Thermolite)	BS502698	8,9,21,22,40,41,42
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Thread, Dacron, (Star Ultra Dee)	BS502782	63
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3M2100 Antistatic Film	MIL-B-81705	57
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3M 3900	—	5
3P Adhesive	—	8
Tie Cord, Nylon, Seine Twine	BS505784	64
Triisopropanolamine (TIPA) Catalyst	BS506323	9,42,58
Trimtex Tape (was Dacron Kappa)	—	50
Tuffcode Mark II Label	MIL-M-87958	35
Tungsten Carbide (325 Mesh Filler)	SAE AMS 7878	59
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Tyrap, Tefzel Cable Tie	—	64
U		
Uralane 5750 Conformal Coating	BS515376	22
V		
Versamid 125 Curing Agent	BS502507	7
Versamid 140 Curing Agent	BS505785	7,40
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BS504227	BORON FILAMENT REINF EPOXY RES	20
BS504228	RTV SIL RUBBER(RTV 566 A/B) POTTING COMPND	8,41
BS504229	GLASS CLOTH TAPE, PRESSURE SENS	46
BS504231	GLASS FABRIC, EPXY RESN IMPREGD	—*
BS504232	PLASTIC SHT, THN LAMNAT COPPER	—
BS504233	EPOXY-FIBERGLASS PREPREG	19
BS504997	RESIN CASTING EPOXY DTL SPEC 4	—
BS505773	DACRON FABRIC (STEVENS 39593)	25
BS505775	ACETAL RESIN DELRIN 500	36
BS505776	POLYIMIDE RESIN SP-3 DTL SPC	38
BS505777	EPOXY RESIN ENCPULNT SCHC 280	41
BS505778	EPOXY RESIN ENCPULNT SCHC 282	41
BS505782	DACRON THREAD (STAR ULTRA DEE)	63
BS505784	NYLON TIE CORD	64
BS505785	POLYIMIDE RESIN VERSAMID 140	7,40
BS506085	RBR, (EPT-10), DETAIL SPEC FOR	—
BS506209	SHELL R 405 CATALYST	—
BS506210	DECOMPOSITION HYDRZINE PROP	—
BS506302	PRIMER, ADH BNDG, BR-127, MATL SP	4
BS506303	PNT, FL BLK, FLEX, TEMP & LT REFL	51
BS506304	EPOXY STRUCT. ADHSV, EA901NA/L-3	10
BS506306	RTV SLCN RBBR SILSTC 881 CTLST	—
BS506308	GRAPHITE FILAMENT, EPOXY RESIN	18
BS506311	HI THRM CNDUCTIVTY EPXY RSN, STYCST 2850 FT/11	9
BS506312	POLYIMIDE PRESS-SENS TAPE(7367)	47
BS506314	SILICONE PRIMER (SYLGARD PRIMER)	5
BS506315	PAINT PRIMER, FOR USE WITH POLY	51
BS506316	DBL COATED XPRNT POLY FILM TPE	48
BS506317	ALIPHATIC POLYEPOXIDE RESIN	12,24
BS506318	CURING AGENT FOR EPOXY RESIN	12
BS506319	SEALANT RTV SILICONE CONT VOLA	6,39
BS506320	POLYURETHANE ELASTOMR DTL SPEC	—
BS506321	EXTRUDED FLUORCARBON-SHEATHING	—
BS506322	EPOXY STRUC ADHESIVE	11
BS506323	TRIISOPROPANOLAMINE (TIPA) DETAIL SPEC	9,42,58
BS506324	THRD, NONMELT NYLON, BOND & STRCH	63
BS506325	POLYIMIDE PRESS-SENSITIVE TAPE	—
BS506328	TEFLON TFE-COATED GLASS FABRIC	25
BS506330	PRIMER ADHESIVE BONDING	4
BS506333	ALUMINIZED POLYIMIDE FILM	27
BS506335	POLYESTER NET	—
BS506337	EPOXY STRUCT ADHSV SUPT FILM	13
BS506339	GRAPHITE FILAMENT, DTL SPEC	—
BS506340	GRAPHITE FABRIC, PREIMPREG EPXY	19
BS511315	ZINC ORTHOTITANATE PAINT (ZOT) OR YB71	56
BS511321	DIGITAL MAGNETIC COMPUTER TAPE	—

*Specification details not included in this document.

APPENDIX C

NUMERICAL INDEX FOR NONMETALLIC MATERIALS SPECIFICATIONS

SPECIFICATION	MATERIAL	SECTION 3.2 PAGE NO.
BS513076	PAINT, CLR, FLEX, PEU (CHEMGLAZE)	53
BS513077	PAINT, F/BLK BOSTIK 463-6-147	52
BS513080	CARBON BLK-ELECT COND FILLER	61
BS513087	GRAPHITE FIL, PRE-IMPREG RESIN	19
BS513090	FOAM-IN-PLACE HI-TMP FPH/FR	59
BS513151	HI THRML CONDUCTG EPXY CAS RES	9,43
BS513156	SOLVENT, SPECIAL, CHEMGLAZE 9951	63
BS513159	MOLD PLYMIDE GRPHT-FIL SP/21, 2	37,38
BS513169	PERFLUOROPOLYALKYLETHER LUBE	32
BS513171	IRON TITANATE (ILMENITE) GRANULS	53
BS513199	MH-11 HI-TEMP RESIST ELEC COND PAINT	54,61
BS513225	NOMEX LACING-TYING TAPE, THERML	61
BS513277	STRUCT ADHSVE FILM/HI TEMP SER	12
BS513278	PRIMER/ADHSVE BONDING (EA9205)	4
BS513305	ADHESIVE, EPOXY FOAMING, DTL SPEC	12
BS513312	EPOXY RES EMBDMT 1090/24LV	43
BS513315	GRAPHITE SIL, HI TEMP INORG PNT	53
BS513317	EPOXY STRCTRL ADH EA907 A/B	10
BS513330	NON-MAG ELEC COND, BLK THERM PNT	55
BS513520	ACRYL ADH XFER TAPE (3M 966) DTL	48
BS513522	FLUOROELASTOMER SOLN (PLV-2000)	8
BS513525	GREASE, RKT PROPL CMPCTB BC-600	31
BS513526	GREASE, RUST PRVNT, BRAYCT-601	31
BS513529	SILICONE FLUID (DC-510)	59
BS513532	QUICK SETG ACRY ADH EA9446 A/B	11
BS513534	THREAD LOCKG/SEALG COMP VC 3	—*
BS513700	SGL STRD, HMX DTNTG CD, 1210 GR	—
BS513988	STRL ADH (EA934/EA956 BLEND)	10
BS514364	CONT VLTLTY RTV, SILICON, CV2510	39
BS515055	EPXY PLYMD STRL ADH, EA934NA A/B	10
BS515059	EPOXY, STRL ADH, EA 9394 A/B	11
BS515265	EPOXY GLASS FAB LAM, UNCLAD	—
BS515376	CTG PC ASSY, URALANE 5750-A/B	22
BS515389	ELASTOMER COMP (CONATHANE EN11)	39
BS515787	HYSOL EPK IC A/B	12,40
BS515790	SOLDER-RESIST HYSOL SR2020	—
BS515830	C/C TST SAMPLE SOLAR PROBE	—
BS515841	ECCOBOND 66 C/9	7
BS515843	ABLETHERM 12-1	6
BS515845	ECCOSPHERES SI	42,58
BS515846	EPOXY STRUCT. ADHSV EA9396 A/B (NO FILLERS)	11
BS515871	EPOXY ADHESIVE, SCOTCHWELD 2216 B/A	42
BS515971	SCOTCHWELD 2216 B/A WITH FILLER	—
BS516165	PAINT, WHITE ZnO + Al ₂ O ₃ SILICATE BINDER	55
BS516205	TAPE, SILICONE, PRESSURE SENSITIVE	49

*Specification details not included in this document.

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Appendix D - Numerical Index for Process Specifications

April 1993



JPL D-9984

JPL STD00009, Rev. B

APPENDIX D

NUMERICAL INDEX FOR PROCESS (FS) SPECIFICATIONS

SPECIFICATION	PROCESS	SECTION 4.0 PAGE NO.
FS500440	RES WELDED ELECT CONNECTIONS	— *
FS500441	GEN SPEC. SOLDERING PROCESS	—
FS500442	PTD WRG & TERMINAL BD FABRICTN	—
FS500443	TRANSFORMERS & INDUCTORS ELECTR PCKGING	6
FS500444	CABLING FABRICATION & ASSEMBLY	—
FS500446	CONNECTOR SEP FORCE TEST	6
FS500447	INTRA WIRING OF SC SUBASSYS	—
FS500449	ADHESIVE BONDING ELEC PKG-CBLG	—
FS500451	IDENT & MRKG METHODS-P&S & ASSYS	8
FS500455	CBLNG FAB & ASSY DTL SPEC	—
FS500628	BUFFING MAG ALLOYS & ELECTROPLTD	—
FS500629	BUFFING S/STEEL HT RSTN ALLOYS	—
FS501410	APLICTN DIELECTRIC MATL SLR PNL	5
FS501411	ADHESIVE BONDING OF SOLAR PANELS	—
FS501423	ANNEALED Ti6Al-4V PRESSURE VESSELS	—
FS501424	APPLICATION OF TEMP CONT PAINT	5
FS501437	S/C FLIGHT EQUIP TEMP CONT PAINTS	15
FS501493	BONDING OF HIGH GAIN ANTENNA	—
BS502695	POLYURETHANE RESIN SYSTEM (SOLITHANE 113)	12
BS502698	THERMOLITE 12 CATALYST	12
FS502703	CTG OF ALUM ALYS ANODIC, BLACK	22
FS502704	PREP & APPL OF PHOSPHATE COATING PAINT BASE	19,20
FS502705	CONVERSION COATING (DOW-19) Mg ALLOYS	23
FS502740	PREP & APP OF SILICONE RUBBER ADHESIVE	—
FS502750	CASE HARDENING OF STEEL	7,20
FS502751	ADHESIVE BONDING SYRINGE TECH	3
FS502752	EPOXY-POLYAMIDE ADHESIVE	3
FS502753	APPL SOLID FILM LUBRICANTS	13
FS502754	CONVERSION COATING (DOW 7)	23
FS502755	COATING, HARD CHROMIUM ALLOY APPLICATION	15
FS502756	PREP & APP OF EPOXY-POLYAMIDE (ECCOBOND 45/15)	—
FS502757	HI VISBL XMTNC LO-EMITNC COATG	5
FS502758	EPOXY RESIN GLASS FAB LAMINATE VACUUM BAG MOLDED	27
FS502759	INSPECTION, NONDESTRUCTIVE PENETRANT METHOD	9
FS502760	WELDING, ELECTRON BEAM	26
FS502761	PREP & APP OF SILICONE RUBBER (RTV-40/T-12)	—
FS502762	PREP & APP OF FLUOROELASTOMER (FAIRPRENE 5159)	—
FS502763	PREP & APP OF 1 PART SILICONE RUBBER ADHESIVES	—
FS502764	LAMINATE, GLASS FAB, POLYESTER RESIN STRUCTURAL	27

*Specification details not included in this document.

JPL STD00009, Rev. B

APPENDIX D

NUMERICAL INDEX FOR PROCESS (FS) SPECIFICATIONS

SPECIFICATION	PROCESS	SECTION 4.0 PAGE NO.
FS502765	COATING, GOLD IMMERSION (ELECTROLESS GOLD)	16
FS502766	CTG GOLD OR AL, VAC DEPOSITED	4
FS502767	EMBED/REINFRM W/EPOXY 1090/11	17
FS502768	APP OF SPRAY FOAM (CPR 385) TO LAMINATED SUBSTRATES	27 — *
FS502769	PREP AND APPL SIL FILLED RBR	27
FS503540	PRCS SPEC SPHER LPG- BALL SEAT	—
FS503904	INSTAL, FASTNRS, BLIND NUT DETLS	11
FS503905	INSTAL, BRGS, PLAIN & BUSHNGS, SINTERED	11
FS503918	INSTAL, RIVET, SELF-PLUG, BLIND	11
FS504040	WORKMANSHIP STANDARDS FOR MECH PARTS & MATERIALS	10,14,27
FS504255	TORQUE RQMT, THRD FASTENERS, STRUCTURAL	14
FS504270	IMPACT INSTLTN, THINWALL INSETS	14
FS504285	VARNISH, INSUL NO. B-142-1, APPL	—
FS504447	LUB, BOND, SOLID FILM BURNISH	13
FS504508	PREP OF SURFACES FOR ADH BNDG	3,19
FS504574	OPT ALIGN-MAWD INSTRUMENT VO75	—
FS504737	TIN PLATING AND FUSING	—
FS504738	GOLD PLATING OF TERMINALS	—
FS504739	ANNEALING OF ELECTRICAL TERMINALS	—
FS505000	WELDING & INSPECTION ACCEPTANCE CRITERIA STEEL & A1	— —
FS505012	BRDGWIRE SYS JPL SQUIBS	—
FS505013	GLASS SEAL & HEAT TREAT SQUIBS	—
FS505014	EPOXY POTTING JPL SQUIBS	—
FS505015	MIX & INSTAL ANTI-STATIC FILL	—
FS505016	WELD ADAPTER TO BODIES-SQUIBS	—
FS505021	WELD CLOSE DISCS 7/8 IN SQUIB	—
FS505022	LOAD MATCH & OUTPUT CHG, SQUIBS	—
FS505029	MATERIAL COMPATIBILITY SPECIMN	—
FS505030	MATL COMP, CAPSUL/TRANSDUCERS	—
FS505069	APP OF SILICONE (GE G-683)	27
FS505080	BRAZE TUBE JOINT PREP & RADIOGR INSP	9,26
FS505144	CORRODED CTD MAG ALY PTS, RPRCS	23
FS505145	PREP & APPLCTN SOLITHN SIL FLK	—
FS505146	GEN CLEANING OF MATL, PRCS SPEC	19,20,24
FS505147	CLEAN BIMETALLIC XITION TUBE	—
FS505149	CHEM MILLING TI-6AL-4V T/ALLOY	—
FS505150	ANLG AND PLTG POLYSULFONE PART	-

*Specification details not included in this document.

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SPECIFICATION	PROCESS	SECTION 4.0 PAGE NO.
FS505153	PREP & APPL OF FLEX EPOXY ADH	3
FS505257	BRAZING PIN-HEADERS FOR JPL SQUIBS	— *
FS505282	TANKS, PROPULSION, TI ALLOY, VO FLT. EQUIP.	27
FS505284	PRNTD WRNG BD & ASSEMBLIES	—
FS505683	GLASS SEALING & HEAT TREATING SQUIB	—
FS505684	EPOXY POTNG OF HEADR ASSY SQUIB	—
FS505685	ANTI-STATIC SHUNT FILLR INSTLTN	—
FS505686	CONN ADAPTR WELDNG JPL SQUIB	—
FS505687	BRIDGWIRE INSTLTN JPL SQUIB	—
FS505688	MATCH HEAD & OUTPUT CHRGS INSTLN	—
FS505689	END CLOSUR WELDNG JPL SQUIB	—
FS505715	HEADR ASSY FABRICTN JPL SQUIB	—
FS505770	SOLDERLESS WIREWRAPPED CONNECTIONS FOR DSN EQUIP	—
FS505793	GLASS SEALING & HEAT TREAT JPL SQUIBS	—
FS505794	EPXY POTNG/HDR ASY SB, 1/2-20	—
FS505795	ANTI-STATIC SHUNT FLR INSTLTN	—
FS505796	CONN ADPTR WLDNG SB, 1/2-20	—
FS505797	BRDGWRE INSTLTN SB, 1/2-20	—
FS505798	MATCH HD & OUT CHARGES, SQUIBS	—
FS505799	END CLOSURE WELDING, JPL SQUIBS	—
FS505813	QA CERT REQ FOR CBLG & HRNSNG	—
BS505814	SPOT BOND, COMPONENT PARTS	18
FS505920	PREP FOR, INSLTN & INSP OF RIVET	10,11,14
FS505925	LT-WT & HVY DTY KEY LCK THD INSR	11,14
FS505985	MNFG REQ MCCC CABLE HARNESS	—
FS505986	GLAS SEALING & HEAT TRTNG SQUIB	—
FS505987	EPXY POTNG/HDR ASSY SQUIB	—
FS505988	ANTI-STATIC SHUNT FLLR INSTLTN	—
FS505989	CONN ADPTR WLDNG SQUIB 5/8-18	—
FS505990	BRDGWIRE INSTLTN SQUIB 5/8-18	—
FS505991	MTCH HD & OUTPT CHRG INSTLTN SQB	—
FS505992	END CLOSUR WLDNG SQUIB 5/8-18	—
FS506020	WIRE WRAPPED ELECT CONNECTIONS	—
FS506025	STRS RLF CYCLING CRIT-CMMN MTLs	7
FS506079	PRINTED WIRING BOARDS & ASSY	—
FS506092	CLEANING & CONTAMINATION CON	—
FS506093	CLN RM REQT FOR RCTN CONT ASSY	—
FS506165	PROP PRESSURE VESSELS Ti-6Al-4V MVM '73	—
FS506299	HDR ASSY FAB JPL SQUIBS	—
FS506300	GEN CLEAN REQ LIQ FLUORINE	—
FS506313	CATALYST C113-300	12

*Specification details not included in this document.

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NUMERICAL INDEX FOR PROCESS (FS) SPECIFICATIONS

SPECIFICATION	PROCESS	SECTION 4.0 PAGE NO.
FS507016	ANODIC TREATMENT OF MAG ALLOYS	23
TS507035	VACUUM OUTGAS OF POLYMERS	25
FS507292	SOLDERING GOLD PLTD FLX-RGD WG	26
FS507296	RF SHLDG G5KT5-CONSIL R-EQUIV	— *
FS509157	SDNG TITANIUM TK EXT-EMSY CONT	—
FS509330	PREP OF SURFACE ADHESIVE BONDG	3
FS509331	PREPAPPL EPOXY ADH-HYSOL 9309	2
FS509332	ELECT ETCH PROC ID OF PRT & ASSY	8
FS509333	PRESS VESSELS HEAT TREATED ALY	7
FS509335	ELECTRICAL DISCHARGE MACHINIG	14
FS509336	PREP & APPLIC, ADHE PRIMER EA 9210	2
FS509337	FILLING EDGES OF HONEYCOMB SND	17
FS509338	BONDING INSERTS INTO HONEY COMB SND	17
FS509339	BUFFING METAL SURFACES	14
FS509340	ASSY BONDING OF COMP TRUSS & BM	2
FS509911	PIN HEADER FAB & ASSY ELECEXP	—
FS509976	SATIN FINISH OF ALUM ALLOYS	—
FS510156	INSTAL & RMVL BLIND PLATE NUTS	—
FS510157	RECVR PROTECT SW FOR SEASAT SAR	—
FS510995	HAND SOLDERING-ELECT CONN-GSE	—
FS511309	REQ UNIVAC 1108 COMPATBLTY DTL	—
FS511310	FAB GRAPHITE EPXY RESN BAT CEL	—
FS511311	ADHESIVE BONDG TANT ALUM LAMNT	2
FS511315	APLCTN ZOT PAINT THRML ESD CON	5
FS511316	QUALF OF CRITICAL FASTENERS	10,27
FS512222	INSTAL & RMVL BLIND PRESS NUTS	—
FS512455	DIGITAL INPUT FILM REC PRODUCT	—
FS512648	PROC MINI PRECISN INSTR BEARNG	—
FS512793	COATING, GOLD VACUUM-DEPOSITED ON METALLIC SUBSTR	4
FS513023	FAB GRAPHITE FIBR PHOTOMET MIR	—
FS513088	ADHESIVE BONDING VAC BAG METHD	2
BS513151	HI THERML COND EPXY CAST RESIN	12
FS513155	CONFORMAL COATG PWB-ZICON SPRY	5
FS513158	FAB-INSTL ANSI-E. THRMCPPL HDWE	—
FS513166	EPOXY-POLY ADHS (EPON 828/V140)	3
FS513170	PROCG MINI PREC INSTRMNT BEARG	—
FS513172	PLASMA SPRAYING IRON TITANATE	5
FS513184	EPOXY ADH, EA956A/B, PREP & APPL	2
FS513185	PREP/APPLC ADHSV PRIMER BR127	2

*Specification details not included in this document.

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NUMERICAL INDEX FOR PROCESS (FS) SPECIFICATIONS

SPECIFICATION	PROCESS	SECTION 4.0 PAGE NO.
FS513200	APPLIC OF GRAPHITE SILICATE HI TEMP RESIST ELECT CONDUCTIVE THERM CONTR PAINT	5
FS513306	PREP/APPL EPOXY FOAM ADH(FM37)	3
FS513307	PREP-APPLICTN EPOXY ADH/EA 956	2
FS513308	FAB/INSP, STITCH WIRE W/MODULES	— *
FS513309	ADHSN/RENFRCMT EPOXY 1095/9	3
FS513310	APPL EPOXY ADH FILM(FM123LVC)	3
FS513311	EMBDMNT/RENFRCMT EPOXY 1090/24	17
FS513316	APPL GRAPHITE SIL ELEC CONDUCT	—
FS513318	PREP/APP EPOXY STR ADH EA907AB	—
FS513320	EPOXY CASTING RESIN 2850FT BLK	—
FS513326	CLEANG REX OXYGEN SERV-PROP SY	—
FS513331	APPL NON-MAG ELE COND BLK PANT	5
FS513413	NYLON MTG PADS, BONDING TO COMP STRUCTURE	3
FP513414	MFG PROCESS PROCEDURE, ELECTR. EQUIPM'T	2,6,8,11,12,16 17,18,19
FS513523	PREPAPPL FLUOROELASTOMER SOLN	3
FS513533	APPLCTN STRCTL ACY ADH EA9446	2
FS513642	ALUMINUM VAPOR DEPOSITION PRCS	4
FS513776	MTG STRAIN GAGES TO FLT HDW	—
FS513782	MTG & RMVL-TEMP ACCLRM & MTG BLK	—
FS514161	APPL OF GREASE, BRAYCOTE 600	—
FS514858	MCKT LEADS RFRMG FOR TOE UP/DN	5
FS515056	PREP & APP OF EA934NA A/B	2
FS515060	PREP & APP OF EA9394 A/B	2
FS515377	APPL OF URALANE 5750 A/B (LV)	—
FS515508	VAPR DEGREASER OPER, DTL SPEC	27
FS515871	SPOT BOND COMP PTS W/SCOTCHWELD 2216 B/A	18
FS515880	NONDESTR EVAL COMP MATL	9
FS515881	NONDESTR EVAL COMP MATL USING ULTRASONICS	9
FS515882	NONDESTR EVAL COMP MATL USING RADIOGRAPHY	9
FS516025	APPL OF SOLID FILM LUB ON CORROSION RESISTANT FASTENERS	13
FS516163	WHT INORG THERM/ESD CNTRL PAINT (NS43G)	5

*Specification details not included in this document.

Flight Materials, Processes, Fasteners, Packaging and Cabling Hardware Selection Guide

Appendix E - Amendments Description of Specification Change

April 1993



JPL D-9984

AMENDMENT PROCEDURE

The purpose of the amendment is to ensure that corrections and changes relating to the Flight Materials, Processes, Fasteners, and Packaging and Cabling Hardware (JPL STD00009, Rev. B) are properly reviewed and incorporated. When an amendment is required, the following steps shall be completed.

STEP

1. Contact the appropriate STD00009 Cognizant Engineer for the document section to be revised.
2. The Cognizant Engineer shall fill out a rough draft of the requested amendment listing the changes desired on Amendment Form JPL 1667. (See Figure 1).
3. The amendment rough draft will be sent to the assigned or designated Technical Editor in the Documentation Section 648.
4. The Technical Editor will type up a formal amendment including names, titles and Section numbers of the required signatures, then return the completed form to the Cognizant Engineer. (See sample in Figure 2).
5. The Cognizant Engineer will review the amendment, and if changes are needed, return it to the Technical Editor for those changes.
6. If no changes are needed, the Cognizant Engineer will sign the document, obtain the required approval signatures, then return the original to the Technical Editor.
7. The Technical Editor will sign and date the amendment, then fill out a Reproduction Order, JPL Form 0199-S (see Figure 3) specifying the number amendment copies to be printed, and also specifying on the Repro Order that 2 copies are to go to Vellum File.
8. The Technical Editor will then forward the original copy of the amendment, the Repro Order, and 2 copies of the appropriate distribution list to the Engineering Data Management Group (EDMG) 171-300, for official release of the amendment.
9. After logging in the release, EDMG will send the amendment, repro order, and distribution lists to the print shop (Foothill Bldg 504) for printing of the specified number of copies.
10. The print shop will send all copies, plus the distribution lists to the Document Distribution Group, 171-119, for lab-wide distribution.
11. The print shop will return the original amendment copy, plus one printed copy, to the Technical Editor for his or her file.

AMENDMENT



JET PROPULSION LABORATORY CALIFORNIA INSTITUTE OF TECHNOLOGY • PASADENA, CALIFORNIA

JPL DOC TITLE:

JPL DOC No. _____

AMENDMENT No. _____

DATE: _____

PAGE 1 OF _____ PAGES

DESCRIPTION OF CHANGE:

NOTE: (■) OR (*) INDICATES AREA OF ACTUAL CHANGE OR NEW MATERIAL ON REVISED PAGES

REMARKS:

RELEASED:

APPROVED:

APPROVED:

PREPARED:

Figure 1. Amendment Form, JPL 1667



AMENDMENT

JET PROPULSION LABORATORY CALIFORNIA INSTITUTE OF TECHNOLOGY • PASADENA, CALIFORNIA

JPL DOC TITLE:

Epoxy Adhesive (EA 9394 A/B)
Preparation and Application of
Detail Specification for

JPL DOC No. FS515060 BAMENDMENT No. B-1DATE: 25 November 1991PAGE 1 OF 1 PAGES

DESCRIPTION OF CHANGE:

Delete Paragraph 3.2.2 f. in its entirety and substitute the following:

- 3.2.2 f. Slowly pour (while stirring) 17 parts by weight (PWB) of EA 9394, Part B curing agent into a vessel containing 100 PWB of EA 9394 Part A resin paste. The curing agent should be added in several portions, stirring briefly and slowly between portions.

NOTE

For any specific weight of Part A (W_A)
determine the weight of Part B (W_B) required
using the following formula:

$$W_B = 0.17 \times W_A$$

SAMPLE COPY

NOTE: (■) OR (*) INDICATES AREA OF ACTUAL CHANGE OR NEW MATERIAL ON REVISED PAGES

REMARKS:

Formula for mixing was incorrect.

RELEASED:

J. W. Anderson
J. W. Anderson
Section 648
Documentation

APPROVED:

T. P. O'Donnell
T. P. O'Donnell
Section 355
Group Supervisor

APPROVED:

PREPARED:

V. F. Hribar 11/4/91
V. F. Hribar
Section 355
Cognizant Engineer

JPL 1667 11/86

Figure 2. Sample Copy of a Completed Amendment

FOR ASSISTANCE PLEASE CALL 7-9375 (FOOTHILL), OR 4-5130 (LAB)
REFER TO: 1. USER'S GUIDE TO DUPLICATING AND PRINTING SERVICES, JPL D-472. 2. SECRETARIAL MANUAL, SECTION IX
3. SPFS: 5-01-10, 5-01-16.
* U.S. GOVERNMENT PRINTING OFFICE: 1951-550-000